SCHOOL OF MINES

OF THE

UNIVERSITY

OF THE

STATE OF MISSOURI,

ROLLA, MISSOURI.

CATALOGUE 1893-95

WITH REPORT OF DIRECTOR.

"WORK IS VICTORY."

—*Emerson.*

Twenty-Fourth Annual Catalogue

of the

School of Mines and Metallurgy

of the

University of the State of Missouri,

Rolla, Missouri.

With

Report of Director.

1894.

COLUMBIA, MO.:
E. W. STEPHENS, PRINTER AND BINDER
1894

Calendar.

1894.

June 14, Thursday, 10 A. M. ..... Annual Commencement.
September 17, Monday, 10 A. M. ... Entrance Examination.
September 18, Tuesday. .... First Term Begins.
November 29, Thursday..... Thanksgiving Holiday.
December 22, Saturday ..... Christmas Holidays Begin.

1895.

January 2, Wednesday ..... Exercises Resumed.
January 21, Monday..... ..... Mid-Year Examinations Begin.
January 26, Saturday..... ... Mid-Year Examinations Close.
January 29, Tuesday..... ..... Second Term Begins.
February 22, Friday..... Washington's Birthday, Holiday.
June 3, Monday. .. .. Final Examinations Begin.
June 11, Tuesday... .... Final Examinations Close.
June 13, Thursday, 10 A. M ..... Annual Commencement.

Report of Director, December, 1893.

ROLLA, MO., DEC. 19th, 1893.

To the Honorable, the President and the Members of the Board of Curators, and the President of the University of the State of Missouri:

SIRS:—I have the honor, according to custom, to submit the following report for the half-year since your last stated meeting.

I. ENROLLMENT, AND CLASSIFICATION OF STUDENTS.

The number of students now registered is 87,—65 Male, 22 Female. This is the largest enrollment for this period of the year in the history of the school.

BY STATES ETC..

Missouri	69
Iowa	4
Colorado	3
Nebraska	2
Montana	2
Illinois	2
California	1
Texas	1
Kentucky	1
Indian Territory	1
Japan	1
Total	87

BY CLASSES,

1. Professional,	
Graduate	1
Senior	4
Junior	7
Sophomore	10
Freshman	23
Special	9
	54
2. Academic	33
Total	87

Average age of all students..... 19.8 years.

Among the institutions last attended are:

University of Missouri (Columbia).....2 (One LL. B.)
Maryville Seminary, Maryville, Mo.
Central Business College, Neosho, Mo.
Rugby Academy, St. Louis, Mo.
Christian Brothers' College, St. Louis, Mo.
William Jewell College, Liberty, Mo.
McAlester Academy, McAlester, Ind. Ter.
Nebraska City Academy, Nebraska City, Nebraska.
Coquille Academy, Coquille, Oregon.
Denver High School, Denver, Colorado.
University of Denver, Denver, Colorado—2.
Toledo High School, Toledo, Iowa.
Western College, Toledo, Iowa.
Cornell College, Iowa.
Colorado School of Mines, Golden, Colorado.
University of Arkansas, Fayetteville, Ark.
University of West Virginia, Morgantown, W. Va.
Realschule, Hamburg, Germany.
L'Ecole Professionelle de l'Est, Nancy, France.

For purposes of comparison, I append a table showing the attendance on December 10th of each year from 1887 to 1893, inclusive, and its character:

	'87	'88	'89	'90	'91	'92	'93
Male	24	30	44	49	50	51	65
Female	20	14	17	19	25	29	22
Total	44	44	61	68	75	80	87
Professional		22	41	44	41	39	54
Academic		22	20	24	34	41	33
Total		44	61	68	75	80	87
Number from other states and countries,	1	6	9	10	7	7	18
Total attendance for years mentioned,	52	66	69	80	83	116	—

The School of Mines during the greater part of its career was woefully unprepared to do the work for which it was intended. Its teaching force was inadequate. For twenty years it presented the spectacle of a scientific school with no professor either of Physics or of Mineralogy and Geology. For fifteen years all its work was done in one unsuitably arranged building. It had no laboratory building, and its equipment was of the meagrest. There was nothing to attract technical students, and it is not strange that they came in small numbers. The wonder is that they came at all. Lacking facilities for presenting instruction consonant with the design of the School, failing consequently to draw the class of students whose benefit was chiefly contemplated in its establishment, those then in authority seemed to have yielded to the adverse circumstances in which they found themselves, and to have sunk the instruction to meet the abilities, the preparation, and the disposition of the actual applicants. Everyone who wished to enter was admitted, and was taught whatever he might elect to study or might be capable of learning. Children of ten and eleven years of age are actually found enrolled. Among the "courses" set down in the Register as having been pursued during one year (1882—'83) are "Commercial," "Preparatory," "Normal," "Business," "English," "Teachers'," "Book-keeping," and "Girl's Course in Arts." During that year there were in attendance 110 students—until last year the largest number in the history of the School—but of these only 13 were recorded as studying Engineering. This policy brought the School into disfavor and disrepute, against the remains of which it has yet to contend. Its results culminated about the years 1886—88. In the session ending in June, 1886 only 46 students entered; in '87—'88 the attendance was 52, of whom probably three-fourths were Academic students.

With 1888 began a new regime; a new Director (Prof. Echols) went into office and a new faculty was installed. The subsequent period has been characterized by a vigorous effort

toward internal improvement—an attempt to enlarge the facilities for scientific instruction both by the provision of new buildings and increased apparatus, and by the addition of needed professorships—accompanied by a resolute endeavor to develop the School on its proper technical side, directing its energies more and more prominently and exclusively into their appropriate channels. The wisdom of the Board has given to us two long-needed new chairs—those of Physics and of Mining and Metallurgy—the foundation of a Physical Laboratory, so essential in any scientific course, has been laid and additions to its equipment are being made as our funds permit; the Chemical Laboratory, whose equipment was already immeasurably beyond that of any other department of the School, has had its needs properly cared for; in the Engineering Department provision in a small way has been made for offering students some practice with tools, which now forms a recognized part of the curriculum of all first-class engineering schools, and recently one or two of the most ordinary and least expensive forms of testing apparatus have been ordered; the appropriation of the last Assembly is about to be realized in a building to contain rooms for detailed and special instruction in Mineralogy and in Geology, and a laboratory for practical demonstration of the processes of Ore-concentration and of Metallurgy. Other material improvements of this period are a "Mess Club House" for the accommodation of students, and an "Athletic Park" for field sports.

The happy result of this improvement and development is becoming apparent. While there has been no sudden leap toward the goal, from whatever standpoint the school be regarded, substantial advance is to be noted. The table above cited helps to tell the story. The attendance in the last five years has more than doubled—rising from 52 in '87–'88 to 116 in '92–'93. More satisfactory than the mere numerical gain, is the fact that the increment has been of a desirable character, and that

with it there has been a notable rise in the general level of the instruction taken. In the first place, the increase has been almost entirely of men, the number of women remaining about stationary. In December '87, twenty-four men were registered; in December, '93 the number is sixty-five. The number of women for the same years is twenty and twenty-two, respectively. It is fair to say, however, that while the natural bent of the school is decidedly masculine, it must not be inferred that the women are doing altogether inferior work. One of them last year completed the course in Assaying, and another is now engaged upon it, while two are studying the Infinitesimal Calculus. In the second place, the increase has been chiefly of technical students—men preparing themselves for some profession of active life. Comparing the enrollment of December '88 with that of the present time, we see that the Academic students have increased one hundred and fifty per cent., while the professional have increased over two hundred and fifty per cent. The "average age" has risen from eighteen in '87-'88 to almost twenty in '93; it is now, I believe, equal to the average for the whole University. People who have not taken the trouble to inform themselves about the school, I am informed, even yet sometimes sneeringly assert of it that "it is merely a local, preparatory school." The refutation of this charge is potentially present in the above tables. Our students come from ten states and territories and one foreign country (Japan). Already eighteen men from outside of the state have come to the School of Mines for its instruction; this is more than half the whole number of foreign students (32) in the whole University during last session. The list of "institutions last attended" shows, outside of our Missouri public schools, a preparation fairly distributed over this country, with two European schools represented by mature men.

I do not at all claim that the School of Mines is now without flaw. The facts show that in the last few years

a gratifying progress in all respects has been made, and it is the intention of the administration to continue as rapidly as may be practicable the work of improvement. Two views of the functions of a scientific school are possible. The one is that it shall teach merely technical essentials, either presuming a preliminary general education or careless as to it; the other, that it shall combine with its scientific instruction a certain amount of general culture. The first is the idea that prevails in Germany and France, where students, before entering the technical universities, must have passed through the *gymnasia* or the *lycees*, and in a very few of our American schools, notably the Thayer school of Dartmouth College. The second is the view upon which the curricula of nearly all American schools of science are based. With characteristic American haste, our young men are in too great a hurry to get into active life to be willing first to give the time necessary to gain a general collegiate education and afterwards to devote themselves for four years more to specifically professional preparation; in the majority of cases, they cannot afford it. Hence our scientific schools find themselves forced either to include a certain amount of the "humanities" in their curricula, or else to turn out scientific graduates whose ignorance of English and the usual branches of a general education puts their Alma Mater to the blush. The School of Mines, it must be confessed, has in the past paid little attention to the non-professional side of their graduates' education. I do not like the idea of sending forth bachelors of science who cannot speak nor write good English, and who have no ability to read productions, scientific or other, in any tongue but their own. So long as we accept our students at the age of eighteen, or sometimes even younger, I think we can scarcely escape the duty of paying more attention to their training in English and such branches as form part of the mental furniture of every well educated gentleman. We now require some English in the Freshman year, and German is

required in the Chemico-Metallurgical course. I hope, however, gradually to add to the requirements in this line in all the courses—as far as we can without over-taxing the student or crowding out any more immediate essential. And this, it seems to me, is the proper sphere of our "Academic department"—to offer the opportunity of good thorough general culture, such as is needed, in connection with purely technical training, to round off the equipment of the accomplished engineer or scientist. The most un-collegiate work of the school has hitherto been done in this department. We propose with the end of the present session to discontinue the lowest work done here, and we shall at the same time endeavor to elevate throughout the instruction given in the department. With the present year, I have begun, myself, to teach a class in French, and I hope that ere long we may be able to demand either French or German of all applicants for graduation.

Perhaps the most obvious criticism on our professional courses is that the entrance requirements are low—that we begin at a not very elevated point in the student's advancement. A man with some knowledge of Algebra and none of Geometry is able to enter our Freshman Class and will find his needs cared for. I should be duly ashamed of this if we stopped short at the other end. But we do not. I can assure you that the requirements in Pure Mathematics at the School of Mines are in excess of those at the majority of scientific schools —that, for instance, more thorough and detailed work in Analytic Geometry and in the Infinitesimal Calculus is demanded than in the average Engineering course. I should be glad to have you compare our Mathematical course with that of any other scientific school that you may choose. At the Mining School, whose curriculum is taken as a sample by the U. S. Commissioner of Education in his last report, a three years' course is given, and students beginning the first year's work are not so far advanced as our students at the beginning

of the third year from graduation; nor is as much time thereafter given to Mathematics as with us. They give 310 lecture hours from this point to Mathematics and Mechanics; we give 342 hours to the same subjects It would not be difficult to sit down, with a pile of catalogues about one, and to construct an ideal course that should possibly surpass any of those at hand. The difficulty would be to find material to fit it. The problem that seems forced upon us is not so much to formulate a course that shall look pretty in our catalogue, as to utilize to the best advantage the energies of the school for the accomplishment of the purpose for which it was established—the training of the young men of Missouri in certain professions. The present *status* of secondary education in the state—especially in the rural parts of it—and the great importance of thoroughness in the fundamental branches, seems to justify the stage at which our courses begin. "It is not what goeth in but that which cometh out, that defileth," and we can stand some lack of altitude in the preparation of our beginning students, if we can be certain of the excellence of the finished product. At the same time, we shall always strive forward; the grade of our Freshmen has been improving, and I hope that we may soon require them to complete Algebra and Geometry in the first semester and to take Trigonometry in the second semester—which would make our Freshman year compare very well with the usual course for that year in scientific schools of the better class.

The creation of the new chair of Mining and Metallurgy will enable us to strengthen our courses in subjects belonging to that Department. It is probable that in the development of this new Department, it will be found advisable to permit to the student certain options according to the specific line in which he may be preparing himself—the Mining Engineer, proper, for instance, needing less of Metallurgy than one who looks forward to employment in connection with a smelter or as an assayer.

II. BUILDINGS AND GROUNDS.

The buildings and grounds are in good condition. During the last vacation, upon the suggestion of Dr. Woodward, then Chairman of the Executive Committee, the superfluous back stair-case on the western side of the main building was removed, and in the space thus obtained, two rooms were constructed. The lower one is an office for the Executive Committee, and has in an alcove, a fire-proof safe in which the records and important books and papers of the Committee are kept. The upper room is utilized as a study room for the women students, and has, in connection with it, a toilet-room—a much appreciated sanitary provision.

The plans of the "Mining and Metallurgical Laboratory" have been approved by the Executive Committee and the Governor, and bids have been invited. The design shows a T-shaped building, the front (76x30) two stories high, and running back from approximately the middle of this the "milling room," one story high and 40x75 feet, adjoining this being the "engine and boiler room," 31x43. The first story, front, contains a Lecture Room, 32x20, arranged so that cases may be set about the walls; a "Blow-pipe Room," 15-6x17; a "Wet Assay Room," 25x14; an "Experimental Laboratory," 14x11-6; an "Office," 14x12-6; a "General Supply Room," 14x9; and a "Room for Departmental Library," 12x7-6. In the second story, are, a room for Petrography, 17-6x12-6; a Drawing Room 37-6x15, lighted by three skylights, and with space for cases and a closet for draughting supplies; a little room for making blue prints, 7-7x7-6; and a store-room, 17x27. The "milling room" is to be fire-proof. It is to contain a small toilet-room, 6x6. The floor-space in the entire building is to be 7117 sq. feet. A cement sidewalk is now being constructed about the eastern and southern sides of the campus.

III. RECOMMENDATIONS.

I shall recommend to the Executive Committee the discontinuance of the course in Mechanical Engineering. We have not the equipment necessary for such a course. It was established by Director Echols in the hope that the requisite laboratory equipment would be supplied, and was continued by his successor with the same view. I do not believe, however, that we should advertise what we are not prepared to teach, and, accordingly, am in favor of ceasing to offer this in our catalogue as a degree course. It is only fair to the late Director, Prof. Harris, to say that he concurs in the propriety of this recommendation. At the same time that I hold this opinion, I am in favor of increasing our facilities for teaching Mechanical Engineering. It is one of the most important elements of the preparation of a Mining Engineer. To indicate how essential it is regarded in a mining education, I may mention that the Michigan Mining School has a full Department of Mechanical and Electrical Engineering, and that the first laboratory which they built was a Mechanical laboratory.

I recommend that the degree of "Mining Engineer" be changed to "Engineer of Mines." I prefer the old form when written in full, but the abbreviated form, M. E., is liable to misconstruction. It is usually understood to stand for "Mechanical Engineer;" and the vastly superior number of Mechanical Engineers who are now being turned out has about succeeded in winning for them recognition of the exclusive right to the title "M. E." There should be an agreement among Colleges as to the meaning of their abbreviations so that the general public may be saved from confusion and uncertainty. It seems to be the usage of the best institutions to leave "M. E." to the Mechanical Engineers, and to confer upon their mining graduates the title "Engineer of Mines," with the abbreviation "E. M.," and, though I am somewhat reluctant, I think that we should conform with recognized custom in this respect.

I beg to suggest for the consideration of the Board the propriety of our working six days in the week. I see no valid reason for the week day's holiday. It is simply a matter of long tolerated custom. It is not needed by students for either mental or physical recuperation. Its abolition would render much easier the arrangement of lectures and recitations, and ought to increase very materially the amount of work accomplished in a session.

I have the honor to be, gentlemen,

Very respectfully,

W. B. Richards,

Director.

Club House. Chemical Laboratory. Main Building.

Board of Curators

of the

University of the State of Missouri.

Term expires January 1, 1895.

Gardiner Lathrop	Kansas City.
B. R. Cauthorn	Mexico.
M. E. Benton	Neosho.

Term expires January 1, 1897.

C. M. Woodward	St. Louis.
Nat. M. Shelton	Lancaster.
W. W. Eads	Carrollton.

Term expires January 1, 1899.

R. B. Oliver	Jackson.
John S. Clarkson	Columbia.
C. C. Bland	Rolla.

OFFICERS OF THE BOARD.

C. M. Woodward	President.
Nat. M. Shelton	Vice-President.
J. G. Babb	Secretary.
R. B. Price	Treasurer.

Executive Committee

of the

School of Mines and Metallurgy.

C. C. Bland - - - - - - - Rolla.
R. B. Oliver - - - - - - - Jackson.
M. E. Benton - - - - - - - Neosho.

OFFICERS OF THE COMMITTEE.

C. C. Bland - - - - - - - - Chairman.
H. H. Hohenschild - - - - - Secretary.
D. W. Malcolm - - - - - - Treasurer.

Faculty.

RICHARD H. JESSE, LL. D., - *President of the University.*

WALTER BUCK RICHARDS, M. A., (University of Virginia.)
Director and Professor of Mathematics.

AUSTIN LEE MCRAE, S. D., (Harvard University.)
Professor of Physics.

ELMO G. HARRIS, C. E., (University of Virginia.)
Professor of Engineering.

WILLIAM H. SEAMON, B. Sc. A., (University of Virginia.)
Professor of Chemistry.

HARRY KINZER LANDIS, B. S., E. M., (Lehigh University.)
Professor of Mining and Metallurgy.

PAUL J. WILKINS, B. S., (Michigan A. and M. College.)
Instructor in Academic Department.

THOMAS L. RUBEY, A. M., (Missouri State University.)
Secretary, and Instructor in Academic Department.

THOMAS GRAYSON POATS, (Grad., Miller School of Virginia.)
Instructor in Shop Work and Drawing.

Administrative Officers.

RICHARD H. JESSE,
President of the University.

WALTER BUCK RICHARDS,
Director of the School of Mines.

THOMAS L. RUBEY,
Librarian and Secretary of the Faculty.

History.

In 1870 the General Assembly of Missouri in accepting the donation of land for educational purposes made by the general government through Act of Congress, approved July 2d, 1862, established an Agricultural and Mechanical College and a school of Mines and Metallurgy. The design of these institutions is set forth in the following language:

Objects of these Colleges.—The leading objects of said colleges shall be to teach such branches as are related to agriculture and the mechanic arts and mining, including military tactics, and without excluding other scientific and classical studies, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. (R. S. 1889, Sec. 8739.)

The Agricultural and Mechanical College was located in Boone county; the School of Mines and Metallurgy was to be located in that county of Southern Missouri which should offer the greatest inducements for such location. A commission was appointed to receive and pass upon proposals looking to this, and after mature investigation and deliberation pronounced in favor of Phelps county. Here in the next year (1871), the School of Mines began its active existence.

The statutes fix the *status* of the School as one of the colleges of the State University. Its affairs are immediately under the supervision of an Executive Committee, consisting of three members of the University Board of Curators elected by that body.

The need of a general culture as a foundation and accompaniment of specifically technical training and the prevailing

absence of facilities for gaining this from the reach of the intended beneficiaries of the institution led to the establishment in 1885 of an Academic course in compliance with the following Act of Assembly:

Academic course of study, etc.—That the obligations of the state to the general government, assumed by the acceptance of the land grant of July 2, 1862, may be more fully discharged, and in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life, the Board of Curators of the State University shall prescribe and adopt a liberal Academic course of study to be taught in the College of Mines and Metallurgy, located at Rolla, in addition to the courses now taught in said school, and may confer the degree of Bachelor of Science upon all students who shall complete said course in said school to the satisfaction of the faculty thereof. (R. S. Sec. 8740.)

The School of Mines is organized and conducted with a view to subserving, as efficiently as possible, the ends set forth in the legislative enactment in reference to it.

Finances.

The proceeds from the sale of the public lands, the grant of which has been referred to, amounts to $332,000, which is invested in state certificates of indebtedness bearing 5 per cent. interest. The School of Mines receives one-fourth of the yearly income thus accruing. By an act of Congress, approved August 30th, 1890, commonly known as the "Morrill Bill," the general government donated to each state and territory, maintaining a college or colleges in accordance with the act of July 2d, 1862, $15,000 for the year 1889-90 which should be increased by $1,000 a year until the donation should reach $25,000 a year this to remain thenceforth an annual appropria-

tion. After deducting one-sixteenth of this fund for the Lincoln Institute, Missouri gives one-fourth of the remainder to the School of Mines.

In 1891, the government returned to the various states the sums collected from their citizens by the imposition during the Civil War of a "direct tax." The amount thus refunded to Missouri was $646,958.33, and the General Assembly of the state won the gratitude of friends of the higher education by establishing this as a permanent endowment for the State University, specifically designating one-fifth as the portion of the income from this source which should belong to the School of Mines. The investment of the fund in 5 per cent. state certificates yields to the school annually $6469.58.

From these three sources, then, the school enjoys an annual revenue of nearly $15,000. Such additional sums as are necessary for its support are furnished by biennial legislative appropriations.

Location.

The School of Mines is situated at Rolla, the county seat of Phelps county. Rolla is a town of about 2000 inhabitants, on the St. Louis and San Francisco R. R., approximately half way between St. Louis and Springfield. It has an elevation of 1140 feet above the sea level, and enjoys an agreeable and notably healthful climate. Not infrequently families from less favored climates move hither, seeking at once the health of the older members, the education of the younger. Its position on a great trans-continental railway system (the "Atchison") renders it readily accessible from all quarters. It is within easy reach of the lead and zinc district of the southwest, and of the lead and iron regions of the southeast, while opportunities to observe processes of mining and smelting the latter ores are close at hand. Visits of inspection to these mining fields are expected to be an important means of instruction.

Technical Courses.

PLAN OF INSTRUCTION.

It is the object of the instruction at this institution first to lay a broad and solid foundation in the way of acquaintance with principles and theory, and to supplement this, wherever possible, by the discipline of practical application in the laboratory and the field. Lectures and recitations are arranged to come in the morning hours, leaving the afternoon for laboratory and field work. This practical work is designed to illustrate and impress principles, to familiarize with the use of instruments and apparatus, to give valuable experience in operations with which the student is to be concerned in the work of his profession, and to afford an opportunity for original investigation. With additions now making, the school will be well provided with laboratories and equipment, of which it makes a large use.

Each applicant for a degree is required during his Senior year to present to the Faculty a Thesis, recording the result of some original investigation or independent research in a subject connected with his course. It must be accompanied with any drawings that may be necessary to illustrate it, and a copy of it must be deposited with the Librarian for preservation. The acceptance of this Thesis as satisfactory is a condition of graduation.

ADMISSION.

Persons of both sexes, sixteen years of age or over, whether residents of the state or non-residents, may be admitted upon evidence of sufficient preparation. The entrance requirements —which are confessedly not high —have been fixed through considerations of the expressed design of the school "to promote the education of the industrial classes," and of the educational opportunities of those whose interests were chiefly contemplated in its establishment. The importance in scientific education of the fundamental branches of mathematics and a frequently observed lack on the part of applicants of thoroughness in them has led to the inclusion of Algebra, Geometry and Elementary Physics in the work of the Freshman year. It has seemed better to teach these subjects than to let the student proceed with insufficient knowledge of them, or to exclude otherwise worthy applicants for delinquency due in many cases to lack of opportunity. At the same time, with the development of our public school system and a perceptible rise in the grade of our entering students it is hoped that it may soon be feasible to advance the conditions of admission. At present to enter the Freshman class a knowledge of English Grammar and Composition, Arithmetic, and Elementary Algebra as far as Quadratic equations is necessary.

Following is a list of Schools whose courses have been approved by the University, and whose diplomas will admit to the Freshman class without examination. By an order of the Board of Curators the student who obtains the highest rank in the graduating class of any of these schools will be admitted without the payment for the first year of the usual entrance fee.

NAME OF SCHOOL.	NAME OF SCHOOL.
Appleton City Academy.	Monroe City High School.
Bethany High School.	Memphis High School.
Bolivar High School.	Moberly High School.
California High School.	Miami High School.
Cameron High School.	Mexico High School.
Carthage High School.	Milan High School.
Carrollton High School.	Missouri Military Acad.
Chillicothe High School.	Montgomery City High School.
Clinton Academy.	Mound City High School.
Clinton High School.	Mountain Grove Acad.
Cooper Institute.	Neosho High School.
Craig High School.	Nevada High School.
Ft. Smith High School.	Odessa High School.
Hamilton High School.	Paris High School.
Hannibal High School.	Perry Institute.
Harrisonville High School.	Plattsburg High School.
Higginsville High School.	Rock Port High School.
Hooper Institute.	Richmond High School.
Independence High School.	Salem High School.
Jefferson City High School.	Salisbury Academy.
Joplin High School.	Savannah High School.
Kansas City High School.	Sedalia High School.
Kemper Family School.	Shelbina High School.
Lamar High School.	Slater High School.
Lancaster High School.	St. Joseph High School.
Louisiana High School.	St. James Mil. Acad.
Macon High School.	St. Louis High School.
Marionville Collegiate In.	Tipton High School.
Marmaduke Mil. Acad.	Trenton High School.
Marshall High School.	Wentworth Academy.
Maryville High School.	Westport High School.
Mayfield-Smith Academy.	Windsor High School.

Total 59

Candidates may be admitted to "advanced standing," (that is to enter the Sophomore or the Junior class) either upon examination in the subjects of the previous year or years, or upon certificate from another institution of work in the

estimation of the Faculty fairly equivalent to that done here by the class into which entrance is sought. Applicants for advanced standing should communicate with the Director as early as possible.

Courses of Study.

The School of Mines offers three complete Technical Courses, each extending through four years, viz:

I. Mining Engineering.
II. Civil Engineering.
III. Chemistry and Metallurgy.

Course I. is a general course in Mining Engineering, having in view all the operations in connection with mining, from the prospecting for the mine to the delivery of the finished product on the market.

Course II. is a course in Engineering as applied especially to Railways, Highways and Municipal Works.

Course III. contemplates especially processes in Mining and Metallurgy subsequent to the delivery of the ore above ground. It fits a man for a position as Chemist and Assayer or in other connection with concentrating plants and smelters.

Two options are offered in the Senior year as the candidate may wish to specialize in the direction of Metallurgy or of Analytic Chemistry.

For the completion of any of these courses the degree of Bachelor of Science is given. The further degree of Engineer of Mines, Civil Engineer or Metallurgical Engineer will either be conferred for an additional year's post-graduate work, approved in quantity and character by the Faculty; or may

be awarded to graduates who have had practical experience in the work of their profession of such duration and value as to warrant its bestowal.

Following is a table giving the distribution of the work required in the courses, with the number of exercises per week in each subject and the hours of the day at which these occur. Readers who seek information as to the content of any course should study it as outlined in the table, turning to the subsequent departmental statements for descriptions of the instruction given in the various subjects.

FRESHMAN YEAR.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
	FIRST TERM.					
8:30- 9:30	English Course III...	3	English Course III....	3	English Course III. .	3
8:30- 9:30	Elementary Physics...	2	Elementary Physics...	2	Elementary Physics...	2
9:30-10:30	Plane Geometry.....	4	Plane Geometry.	4	Plane Geometry.	4
9:30-10:30	Elementary Physics. .	1	Elementary Physics..	1	Elementary Physics...	1
10:30-12:30	Drawing (Section I)..	2	Drawing (Sec. I).....	2	Drawing (Sec. I).....	2
10:30-12:30	Shop Practice (Sec. I).	2	Shop Practice (Sec. I)	2	Shop Practice (Sec. I)	2
2:00- 3:00	Higher Algebra.....	5	Higher Algebra..... .	5	Higher Algebra.....	5
3:00- 5:00	Drawing (Section II).	2	Drawing (Sec. II). ...	2	Drawing (Sec. II)....	2
3:00- 5:00	Shop Practice (Sec. II)	2	Shop Practice (Sec. II)	2	Shop Practice (Sec. II)	2
	SECOND TERM.					
8:30- 9:30	English Course IV....	3	English Course IV....	3	English Course IV....	3
8:30- 9:30	Elementary Mechanics	2	Elementary Mechanics	2	Elementary Mechanics	2
9:30-10:30	Solid Geometry.....	4	Solid Geometry..... .	4	Solid Geometry.	4
10:30-11:30	Elementary Chemistry	3	Elementary Chemistry	3	Elementary Chemistry	3
10:30-12:30	Drawing (Sec. I).....	2	Drawing (Sec. I).....	2	Drawing (Sec. I).....	2
10:30-12:30	Shop Practice (Sec. I).	2	Shop Practice (Sec. I)	2	Shop Practice (Sec. I)	2
2:00- 3:00	Higher Algebra.....	5	Higher Algebra.....	5	Higher Algebra.....	5
2:00- 3:00	Drawing (Sec. II)... .	2	Drawing (Sec. II).....	2	Drawing (Sec. II)....	2
2:00- 3:00	Shop Practice (Sec. II)	2	Shop Practice (Sec. II)	2	Shop Practice (Sec. II)	2

SOPHOMORE YEAR.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
	FIRST TERM.					
8:30– 9:30	Descriptive Geometry.	2	Descriptive Geometry.	2	Descriptive Geometry.	2
8:30– 9:30	Surveying	1	Surveying	1		
9:30–10:30	Trigonometry.	5	Trigonometry.	5	Trigonometry.	5
10:30–11:30	French or German	3	German or French	3	German.	3
11:30–12:30	General Inorganic Chemistry	3	General Inorganic Chemistry.	3	General Inorganic Chemistry	3
2:00– 5:00	Drawing and Field Practice	3	Drawing and Field Practice.	3	Drawing	2
1:30– 5:30	Chemical Laboratory.	2	Chemical Laboratory.	2	Chemical Laboratory.	3
	SECOND TERM.					
8:30– 9:30	Surveying	2	Surveying	2		
8:30– 9:30	Stereotomy	1	Stereotomy	1	Stereotomy	1
9:30–10:30	Analytic Geometry	5	Analytic Geometry	5	Analytic Geometry	5
10:30–11:30	French or German	3	French or German	3	German.	3
11:30–12:30	Applied Chemistry	3	Applied Chemistry	3	Applied Chemistry	3
2:00– 5:00	Drawing and Field Practice.	2	Drawing and Field Practice	3	Drawing	2
1:30– 5:30	Chemical Laboratory.	3	Chemical Laboratory.	2	Chemical Laboratory.	3

JUNIOR YEAR.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
	FIRST TERM.					
8:30- 9:30	Analytic Geometry and Calculus	3	Analytic Geometry and Calculus	3		
8:30- 9:30	*French	2	French	2	Theoretical Chemistry	3
9:30-10:30	Mining	2	Civil Engineering	2	Ore Dressing	2
9:30-10:30	Ore Dressing	2				
10:30-11:30	Physics	3	Physics	3	Physics	3
11:30-12:30	*German	3	German	3	German	3
10:30-12:30	Mineralogy	2	Mineralogy	2	Mineralogy	2
2:00- 5:00	Drawing and Field Practice	1	Drawing and Field Practice	3		
1:30- 5:30	Chemical Laboratory	4			Chemical Laboratory	4
Mondays.	Mining Laboratory				Mining Laboratory	
	SECOND TERM.					
8:30- 9:30	Infinitesimal Calculus.	3	Infinitesimal Calculus.	3		
8:30- 9:30	French or German	2	French or German	2	German	2
9:30-10:30	Materials of Engineering—Masonry Construction.	2	Materials of Engineering—Masonry Construction.	2	Theoretical Chemistry	3
9:30-10:30	Metallurgy	2			Metallurgy	2
10:30-11:30	Physics	3	Physics	3	Physics	3
11:30-12:30					Ore Dressing	2
10:30-12:30	Mineralogy	2	Mineralogy	2	Mineralogy	2
2:00- 5:00	Drawing and Field Practice	1	Drawing and Field Practice	3		
2:00- 5:00			Physical Laboratory	2		
1:30- 5:30	Chemical Laboratory.	4			Chemical Laboratory.	5

*Alternative.

SENIOR YEAR.

FIRST TERM.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
8:30- 9:30	Geology	2	Geology	2	Geology	2
8:30- 9:30	Metallurgy	1			Metallurgy	2
8:30- 9:30	Economic Geology	2			Economic Geology	1
9:30-10:30						
10:30-11:30	Hydraulics and Graphic Statics	5	Hydraulics and Graphic Statics	5	Works, Management, etc	3
11:30-12:30	Dynamo Machinery	2	Dynamo Machinery	2	Dynamo Machinery	2
11:30-12:30	Analytic Mechanics	3	Analytic Mechanics	3	Metallurgical Problems	2
2:00- 5:00	Physical Laboratory	2	Physical Laboratory	2	Physical Laboratory	2
2:00- 5:00	Drawing	1	Drawing and Field Practice	3	Designing	1
2:00- 5:00	Metallurgical Laboratory	1			Metallurgical Laboratory	2
2:00- 5:00	Mining Designs	1				
					Chemical Laboratory.	

SECOND TERM.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
8:30- 9:30	Geology	2	Geology	2	Geology	2
8:30- 9:30	Metallurgy	2			Metallurgy	2
8:30- 9:30	Ore Deposits	1				
9:30-10:30			Bridge and Sanitary Engineering	2	Metallurgical Problems	2
10:30-11:30	Applied Electricity	2	Applied Electricity	2	Applied Electricity	2
10:30-11:30	Mining	2	Bridge and Sanitary Engineering	3		
11:30-12:30	Prime Movers and Power Transmission	3				
11:30-12:30	Mechanics of Machinery	2	Mechanics of Machinery	2		
2:00- 5:00	Physical Laboratory	2	Physical Laboratory	2	Physical Laboratory	2
2:00- 5:00	Drawing	1	Drawing and Designing	3	Designing	1
2:00- 5:00	Mining Designing	1				
2:00- 5:00	Metallurgical Laboratory	1			Metallurgical Laboratory	2
					Chemical Laboratory and Thesis	

The table shows the Metallurgical option in the Senior Year of Course III. Those who wish to specialize in the direction of Analytic Chemistry will in that year take Geology (2) and Metallurgy (2) throughout the year and Physical Laboratory (2) in the first term, devoting all the remainder of their time to work in the Chemical Laboratory.

Special Courses.

For the benefit of those who may lack the time, the money, or the inclination to spend four years in preparation for professional work, certain special courses, designed to confer competent knowledge of particular departments of engineering work, are offered. These are

I. SHORT COURSE IN MINING.

This is a practical course, intended to include subjects most immediately essential for the successful conduct of mining operations. It is hoped that it may commend itself especially to practical miners who may desire to better their positions or to become capable of more intelligent and economical mining work. It is believed that the time and the money spent in pursuing this course would be profitably invested. The course extends through two years:

FIRST YEAR.

First Term.	*Times per Week.*	*Second Term.*	*Times per Week.*
Algebra	5	Algebra	5
Geometry	4	Geometry	4
Elementary Physics	3	Elementary Chemistry	3
Geology	3	Geology	2
		Ore Deposits	1

Shop Practice, Drawing.

SECOND YEAR.

Trigonometry	5	Surveying	2
Mining	2	Mining	2
Mineralogy	2	Mineralogy	2
Surveying	1	Ore Dressing	2
Descriptive Geometry	2	Stereotomy	1

Drawing, Design, Field Practice, Mining Laboratory.

In the second year the student shall elect from available subjects enough to give him not less than fourteen lectures and recitations per week.

II. ASSAYING.

This course, which is outlined on page 42, may with diligence be completed by mature students who have some knowledge of Chemistry in one year. An additional year, which may in some cases be necessary, may in all cases be profitably spent in more work in Analytical Chemistry and related electives.

III. SURVEYING.

The purpose of this course is to turn out competent Land and Mine Surveyors and fair draughtsmen. The essentials of it are a thorough knowledge of Algebra, Geometry, Trigonometry, Surveying, Descriptive Geometry and Stereotomy, with Field Practice and Drawing. It may be completed in one year or in two years according to the advancement of the applicant upon entrance.

IV. ELECTRICITY.

This course is designed to fit the student for the intelligent management of electric lighting or power plants and for the applications of electricity to mining operations. While practical details are entered into in some directions, the entire course is laid out with a view to giving the student a good foundation for the profession of electrical engineering.

FIRST YEAR.

First Term.	*Times per week.*	*Second Term.*	*Times per week.*
Higher Algebra	5	Higher Algebra	5
Elementary Geometry	4	Elementary Geometry	4
Elementary Physics	3	Elementary Mechanics	2
Special Electricity	2	Electrical Engineering	2

Shop Work, Physical Laboratory, Drawing.

SECOND YEAR.

Trigonometry	5	Physics	3
Physics	3	Applied Electricity	2
Dynamo Machinery	2	Dynamo Machinery	2

Physical Laboratory, Drawing.

In the second year the student shall elect enough additional work to give him not less than fourteen lecture hours per week.

For the satisfactory completion of any of these special courses a certificate of proficiency in the course pursued is granted.

Engineering.

PROF. HARRIS.

T. G. Poats, Instructor in Shop Work and Drawing.

FRESHMAN YEAR.

Shop Work.—All Freshmen spend four hours a week in the shop. The School is at present prepared to give instruction only in wood-work. This is essentially Manual Training, and comprises exercises in joining, carving, turning and constructing. The use and care of tools is first taught. This is followed by a carefully graded series of exercises, at first of an elementary character, subsequently leading up to the more difficult problems in the carpentry of engineering construction.

Drawing.—The student is familiarized with the draughting instruments by appropriate exercises in copying and in shading with the ruling pen; scaled drawing from detail plates; brush shading for plane and curved surfaces; free hand drawing from copies and models.

SOPHOMORE YEAR.

FIRST TERM.

Descriptive Geometry.–Theory of parallel and of central projections as applied to the science of drawing, with numerous exercises in determining projections of familiar objects,

intersections of plane and of curved surfaces, sections, developments and shadows. (Text—Low's Descriptive Geometry.)

Field Instruments.—The field instruments of the engineer are dissected and studied in every detail, their theory, construction and adjustments receiving careful attention. Their uses and capabilities are thoroughly discussed and applied in field practice. (Lectures.)

Drawing.—Much of the time given to drawing in this term is devoted to the exercises in descriptive geometry. Finished plats of all surveys made in field practice will be required.

Field Practice.—The student is first taught to adjust the instruments properly and to test their accuracy. Problems are then assigned in traversing and parting off land, in direct and indirect leveling, and in triangulations, all of which must be carried out in the field.

SOPHOMORE YEAR.

SECOND TERM.

Engineering Geodesy.—General and particular methods of traversing, triangulating, direct and indirect leveling; land, city, topographical, hydrographical and mine surveying; United States systems of subdivisions of land. (Text—Johnson's Surveying, with lectures.)

Perspective Drawing.—(Lectures.)

Stereotomy.—The application of Descriptive Geometry to the art of stone-cutting—obtaining the projections, templets and directing instruments for the individual stones in the various forms of structures and the construction of models of the same. (Text—Warren's Stone-Cutting, with lectures.)

DRAWING.—Some complete engineering structure must be presented in isometric, another in perspective. A neat topographical map must be made from notes taken in field practice.

FIELD PRACTICE.—The exercises in field practice are continued. Topographical Surveying will receive particular attention.

JUNIOR YEAR.

FIRST TERM.

RAILWAY ENGINEERING. *(Civil Engineering Course.)*—Surveys, construction and maintenance of railways. (Text—Searles' Field Book, with lectures.)

STREET AND HIGHWAY ENGINEERING. *(Civil Engineering Course.)*—Surveys, construction and maintenance. (Text—Byrnes' Highway Construction, with lectures.)

DRAWING.—The work assigned in drawing is adapted to the profession chosen by the student. It will consist of plats, profile and sections from notes taken in field practice, and of working drawings of simple engineering structures. Such drawings must be accompanied by estimates of material and of cost.

FIELD PRACTICE.—The student is exercised in Railway Surveying and in setting out earthwork and masonry. A map, profile and estimate of cost of a section of a railway must be produced from notes taken in field practice.

JUNIOR YEAR.

SECOND TERM.

EXPLOSIVES—BLASTING AND TUNNELING.

MATERIAL OF ENGINEERING.—The principal timbers, metals, stones, clays, cements, etc., used in engineering constructions are studied; the investigation including sources of supply, demand, preparation and modes of preservation. (Lectures.)

MASONRY CONSTRUCTION.—Foundations, strength and stability of stone and brick masonry, concretes, cements and mortars. Specifications. (Text—Baker's Masonry Construction.)

FIELD PRACTICE AND DRAWING.—Work of First term continued. The standard method of testing cement will be carried out in detail.

SENIOR YEAR.

FIRST TERM.

HYDRAULICS.—Collection and measurement of water; conveyance through pipes and canals; design of pipe lines. (Text—Merriman's Hydraulics.)

STATICS AND ENGINEERING STRUCTURES.—General study of static forces—graphically and analytically—with applications in determining conditions of stability of engineering structures and strains in simple framed structures; design of beams and posts.

FIELD PRACTICE AND DRAWING.—Senior classmen must direct and check the work of the Sophomore and Junior classes. A variety of exercises in graphical statics will be assigned.

SECOND TERM.

BRIDGE ENGINEERING.—*(Civil Engineering.)*—Loads on bridges and roofs, strains in pieces—design and dimensions of pieces; design of connections. (Text—Johnson's Structures and Dubois' Strains in Framed Structures.)

PRIME MOVERS.—*(Mining Engineering.)*—Hydraulic motors, steam engines and boilers.

TRANSMISSION OF POWER.—*(Mining Engineering.)*—By cable, compressed air and electricity.

SEWERAGE, WATER SUPPLY OF CITIES, AND IRRIGATION. —*(Civil Engineering.)*

FIELD PRACTICE AND DRAWING.—Field work continued as in past terms. Detail working drawings of some of the structures studied will be required. The thesis must be accompanied by illustrative drawings.

LABORATORY WORK.—*(Mining Engineering.)*—Experiments with the indicator, calorimeter and dynamometer.

Chemistry.

PROF. SEAMON.

The instruction in this department is solely intended to meet the requirements of those preparing themselves for positions as Assayers, Chemists, Metallurgists and Mining Engineers. Scarcely any attention whatever is paid to the subject of Organic Chemistry. Each year instruction in the following courses is regularly given:

I. Elementary Inorganic Chemistry. II. General Inorganic Chemistry. III. Theoretical Chemistry. IV. Applied Chemistry. V. Qualitative Analysis. VI. Technical Analysis and Assaying. VII. Quantitative, Mineral, Water, Gas and Commercial Analysis.

I. ELEMENTARY INORGANIC CHEMISTRY.—In this course careful detailed instruction is given in the elementary principles of Chemistry with a description of the most important elements and compounds and the formation and solution of chemical equations.

II. GENERAL INORGANIC CHEMISTRY.—This course differs from the first in that the instruction is more advanced and the treatment is necessarily more comprehensive and exhaustive. Regular exercises are given in Stoichiometry.

III. Theoretical Chemistry.—In this the student reviews the history and development of chemical theory, the physical and chemical properties of "atoms" and "molecules" and the laws controlling them. The instruction is intended for those who are preparing themselves as Chemists and Metallurgists.

IV. Applied Chemistry.—The instruction is by lectures, and covers the chemistry of cements, mortars, explosives, oils, varnishes, paints, fuels and other non-metallic materials employed in engineering operations. The processes of manufacture are also considered.

V. Qualitative Analysis.—The student is thoroughly drilled in the uses of the blowpipe and wet tests for the detection of the metals, acids and bases, commonly occurring in alloys, minerals, rocks and waters. The exercises are arranged in graded series of increasing difficulty. Each series must be completed to the satisfaction of the instructor before the student is allowed to begin the next. The time required by the average student, to complete the course in one session, is about fifteen hours per week.

VI. Technical Analysis and Assaying.—The student is first required to make complete analyses of Barium Chloride; Di-Sodic Phosphate, Strontium Nitrate, Nickle Ammonium Sulphate and Manganese Carbonate. Afterwards he is drilled in the valuation of coals and the ores of lead, zinc, iron, copper, silver, gold, tin and manganese. Complete analyses of fluxing materials, slags, mattes, steel, iron, bullion, lead and zinc are required. The methods taught are those commonly employed for quick determinations in mining and metallurgical plants. Each student makes two hundred assays of lead, silver and gold ores by five methods. To complete the course in one session the average student usually works about twenty-four hours each week.

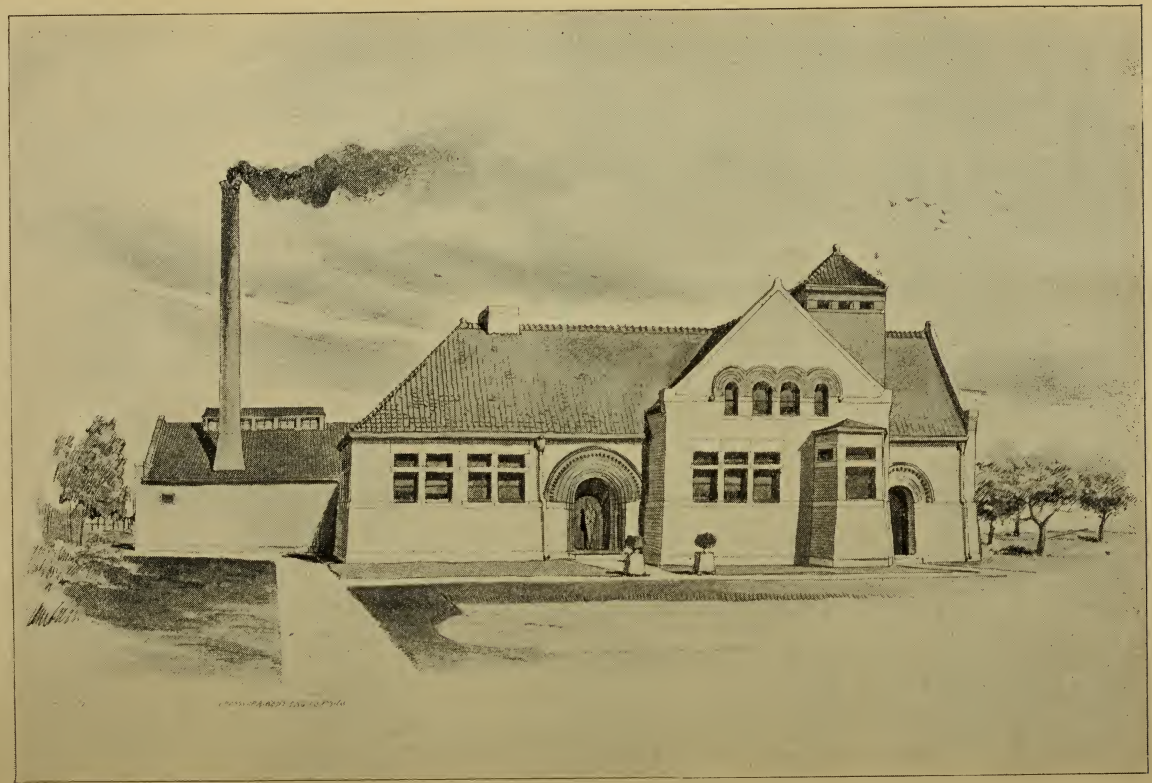
VII. Quantitative, Mineral, Water, Gas and Commercial Analysis.—The exercises in this course may be varied somewhat to meet the peculiar requirements of individual students. In general, methods of analysis are investigated and applied to minerals and technical products; furnace gases and natural waters are analyzed. Special attention is paid to methods for the commercial analysis of oils, fats, paints, varnishes, cements and clays. An extensive course of chemical reading is arranged for each student. The instruction is primarily intended for students preparing themselves for positions as Analytical and Consulting Chemists. The student taking the course is expected to devote about forty hours a week, throughout an entire session, to reading and work in the Chemical Laboratory.

Each Laboratory class meets once each week in conferences over new methods and forms of apparatus employed in chemical work. The qualities of self-reliance and confidence are developed as far as possible in the student. Thoroughness, accuracy and reasonable rapidity are insisted upon, and each student is required to repeat the exercise until he attains a high degree of proficiency.

An Assayer's Certificate is given to students who complete courses II, IV, V and VI. Good workers can complete them in one year by devoting their entire time to the work.

No extra charge is made for the privilege of working in the Chemical Laboratory; but each student is required to pay for the materials he may consume and the apparatus he may break. Supplies and materials may be obtained from the school at cost prices. The cost of taking the several courses should not exceed the following sums: For the course of Qualitative Analysis, $15.00; in Technical Analysis and Assaying, $50.00; and in the Quantitative, Mineral and Gas Analysis, $25.00.

Text-books and works of reference. Notes of the Professor; Roscoe's Elementary Chemistry; Cooke's Chemical Philosophy; Fresenius' Qualitative and Quantitative Analysis; Classen's Mineral Analysis; Crooke's Select Methods; Furman's Technical Analysis; Watt's Dictionary of Chemistry; Wagner's Chemical Technology; Thorpe's Dictionary of Applied Chemistry, etc.



Mining and Metallurgical Laboratory.

Mining and Metallurgy.

PROF. LANDIS.

Instruction in this department is embraced in the following three courses:

COURSE IN MINERALOGY AND GEOLOGY.

Mineralogy.
Lithology.
Dynamical Geology.
Historical Geology.
Economic Geology.

COURSE IN MINING.

Lectures in Mining.
Mine Surveying.
Ore Dressing.
Mining Design.
Mining Laboratory.

COURSE IN METALLURGY.

General Metallurgy.
Metallurgy of Iron, Copper, Lead, Zinc, Gold, Silver, Aluminium, etc.
Metallurgy Problems.
Works Management.
Metallurgical Design.
Metallurgical Laboratory.

The subjects taught, and the method of instruction, are intended to fit a man for the direct application of such subjects in the actual work which he will be required to do in the engineering profession. The same facility with instruments and quickness in getting out work of any kind, cannot be

obtained in a school with the short time available, as can be realized in actual engineering work. But the best ways of doing things, such as are practiced in our most successful works and mines, with actual work in applying their methods, goes a great way toward fitting a man for his chosen sphere of usefulness. Problems, Projets, Memoirs, Reports on assigned work, visits of inspection to mines, works, etc., with Geological excursions, are made a prominent feature in the courses. Actual testing work and original experimental work in the Mining and Metallurgical Laboratory, which is especially designed for that class of instruction, will make the student familiar with methods for determining the economy of any process or operation. The student is made to think for himself as much as possible.

SYNOPSIS OF COURSES.

COURSE IN MINERALOGY AND GEOLOGY.

MINERALOGY—.A two term course including crystallography, practical determination of minerals by their physical characters, by their blowpipe characters, lithology and the practical determination of rocks. The necessary elementary principles are given by lectures, but the work is principally practical determination.

LITHOLOGY.—This subject is treated as a continuation of MINERALOGY.

DYNAMICAL GEOLOGY.—Leconte's Element's of Geology is used as a text. The work is continued into the making of Geological sections and Geological field work.

HISTORICAL GEOLOGY.—The same text is used as above, supplemented by some practice in the determination of fossils. Particular attention is paid to the character of the rocks in the various formations.

ECONOMIC GEOLOGY.—This is a course of lectures and recitations on the products of economic value from the different geological formations. Ore Deposits is included here.

COURSE IN MINING.

LECTURES IN MINING.—Lectures on Prospecting, Exploitation, Extraction, Transportation, Drainage, Ventilation, Lighting, Accidents, Mining Law, Hygiene and Special Methods extend through two terms, and cover the entire field. Projets are assigned to the class involving individual investigation. Memoirs and Reports to the Department are required on all investigations and visits of inspection. Special attention is given to the economical working of mines.

MINE SURVEYING.—The best methods employed are taught by lectures and recitations. Practical work, followed by making of mine maps from the notes is required. The instruction is included under LECTURES ON MINING.

ORE DRESSING.—Lectures, Memoirs. Location of Plant, Hand dressing, Crushing, Comminution, Classification, Concentration, Preparation of Coal, Special Methods. An additional term is given to the students in Metallurgy on advanced work in the preparation of ores for smelting.

MINING DESIGN.—Projets in Mining and Metallurgy. Design and working drawings of mine cars, cages, etc. Mine maps. All work is original and from specifications. Design of Plants. Geological sections from field notes. Thesis work.

MINING LABORATORY.—Every Monday, for one term, is devoted to work in Ore Dressing on Practical Tests of Ores. The Laboratory is fitted with a full-sized Ore Dressing Plant, having several types of machines for the same use, thus allowing comparative tests to be made on any ore submitted. Memoirs are required on all work.

COURSE IN METALLURGY.

GENERAL METALLURGY.–A full course of lectures covering the application of chemistry to metallurgy; formation, fusibility and calculation of silicates; fluxes; furnaces; refractory materials; chimneys; melting points; pyrometry; heat of combination; fuels, natural, artificial, and gaseous; combustion; fire-places; gas producers; utilization of products, etc., is given in the second term, Junior year. Practical problems are assigned to the class for solution throughout the course. These problems are an important feature in that they require the men to apply all the information they may have acquired and give them facility in the use of data; they are an introduction to Special Metallurgical Problems, and Metallurgical Design.

METALLURGY OF IRON, COPPER, LEAD, ZINC, GOLD, SILVER, ALUMINUM, ETC.—Text-books are used where available; remainder of instruction is by lectures and references. Special attention is paid to Missouri ores and products. Baurman, Phillips, Peters, Hofman, etc., are the authors used as texts.

METALLURGY PROBLEMS.—Under this head, special attention is given to subjects not taught in the school which are necessary to solve the problems; to the methods employed in the solution of problems in advanced Metallurgy; to heat distribution, expense distribution, calculation of charges, variations in charges, distribution of power, criticism of designs, designs from specifications, etc. It is preliminary to Metallurgical

Design. The aim of the instruction is to get the students' knowledge in such a form that he can utilize it with ease, and reduce opinions to figures.

Works Management.—Nowhere does system appear to better advantage than in the management and laying out of a mining or metallurgical plant. It is a matter of dollars and cents. A course of lectures covering the entire ground is given on this subject.

Metallurgical Design.—The design of processes, laying out of works, design of furnaces with appropriate accessory machinery is taught in the draughting room. The practice here, as elsewhere, is the most approved modern methods as used in the best designing-rooms in this country. All work is original and done from specifications. Thesis work.

Metallurgical Laboratory.—This work is intended not only to illustrate practically some of the principal metallurgical processes, but mainly to make actual tests, with the necessary analyses, of processes in operation in order to determine the efficiency of the process.

Determination of temperature, calorific power of fuels, fusibility of refractory materials, making of alloys, examination of materials sent to us, in short, practice in such operations as a metallurgical engineer must at some time have use for. The Laboratory is admirably fitted for this class of work. Memoirs are required on all original work.

Mathematics.

PROF. RICHARDS.

The exceeding importance of Mathematics as the basis of a scientific education justifies the emphasis laid upon it in the school. At the same time that the facts are taught, the utility

of mathematical study as a mental discipline is duly recognized, and an effort is made to promote habits of exact, logical reasoning, and to stimulate originality and independence of thought.

In the Engineering courses the ultimate intention of the student is kept prominently in mind, and such points as have an especial bearing upon his technical work are emphasized as occasion may suggest. The tendency, however, too frequently observable in technical schools, to cramp the mathematical instruction within the limits of a meagre preparation for professional work, is avoided, and the treatment of each subject is in general, designed to be as broad and full as may be in the allotted time.

At each meeting the class is examined on matter previously assigned, and, when expedient, explanations of the text and supplementary lectures and notes are given. The student is constantly exercised in work at the blackboard, reproducing demonstrations and applying demonstrated principles to the solution of special examples.

FRESHMAN CLASS.

ALGEBRA.—The course in Algebra will include a rapid review of the elementary processes, a wider discussion of problems leading to equations, with the interpretation of their results, Theory of Exponents, Surds, Imaginaries, the Progressions, Permutations and Combinations, Binomial Theorem, Series, Logarithms, Theory of Numbers, Determinants, with an introduction to the Theory of Equations.

Text-Book.—Wells' University Algebra, with notes.

GEOMETRY.—At the same time the class takes a thorough course in the old (Euclidian) Geometry, with numerous original exercises. *Text-Book*—Wells' Plane and Solid Geometry. Required in all the courses.

SOPHOMORE CLASS.

The Sophomore class studies TRIGONOMETRY, Plane and Spherical, throughout the first half of the year. The class is thoroughly drilled in the Fundamental Definitions and Formulæ. The construction and use of Logarithmic tables are taught, and numerous examples in the solution of triangles, involving the use of Logarithms, are given. Occasionally actual heights and distances are required to be calculated by Trigonometric methods.

The second half of the year is taken up with the study of the CONIC SECTIONS and a few of the Higher Plane Curves.

Some Notes on the Infinitesimal Calculus are given, and the student is taught to use them, especially in developing tangent and normal equations.

Text-Books.—Wells' Plane and Spherical Trigonometry, Wentworth's Analytic Geometry.

For Reference.—Todhunter's Plane and Spherical Trigonometry, Puckle's Conic Sections, Salmon's Conic Sections Searle's or Henck's Field Book.

JUNIOR CLASS.

The class begins with ANALYTIC GEOMETRY OF THREE DIMENSIONS, studying chiefly surfaces of the second degree. The remainder of the year is devoted to the INFINITESIMAL CALCULUS. The student is guarded against the error of supposing that the Calculus means some certain body of knowledge, small or large, and is taught to view it in its true light as a method of analysis, the applications of which are infinite. The logical foundation of the subject is firmly laid in the Doctrine of Limits, and the class is introduced to the applications—both geometrical and mechanical—of its principles, which are most important, both on account of the intrinsic utility of their results, and, as well, as illustrating the efficiency of the instrument which the student is learning to use.

Text-Books.—Venable's Notes on Solid Geometry, Taylor's Elements of the Calculus (with Notes and Lectures).

For Reference.—Salmon's, Todhunter's and Williamson's mathematical works.

SENIOR CLASS.

Students in the Freshman class have a course in MECHANICS, in which only Elementary Mathematics is used. In their Senior year they study the same subject with the use of the Calculus. The instruction extends through the first term.

Text-Book—Bowser's Analytic Mechanics.

GRADUATE STUDENTS.

Graduate students who elect work in this department will be permitted to exercise considerable latitude of choice, within the approval of the Professor. They may make a wider study of the Conic Sections by both Algebraic and Projective methods (Salmon, Cremona), Advanced Calculus (Williamson), Theory of Equations (Burnside and Panton), Determinants (Muir or Weld). Or, if they desire to pursue subjects more directly related to the physical sciences, they may take Dynamics (Williamson), Quaternions (Kelland and Tait), Differential Equations (Forsyth).

In all the classes, as each subject is taken up its origin and development are studied too, and at certain periods, more formal lectures on the History of Mathematics are given.

A collection of the chief works on Mathematics, in English, French and German, which is contained in the Library, affords the student an opportunity of extending his research at will.

Physics.

PROF. McRAE.

FRESHMAN CLASS.

ELEMENTARY PHYSICS.–Properties of matter, heat, electricity and magnetism, sound and light. Three recitations and lectures during the first term. Elements of Physics by Carhart and Chute.

ELEMENTARY MECHANICS.—Solids: composition and resolution of velocities and accelerations, Newton's laws of motion, laws of falling bodies, measurement of force, simple machines, theory of equilibrium, center of gravity. Fluids: barometer, Boyle's law, air, force and suction pumps. Twice a week during the second term. Lessons in Elementary Mechanics by Magnus.

JUNIOR CLASS.

MASS PHYSICS.—Kinematics, Work and Energy, Attraction and Potential, Properties of Matter. *Sound. Heat*—Thermometry, Calorimetry, Specific Heat, Coefficients of Expansion, Heats of Fusion and Vaporization, Thermodynamics. Three times a week during the first term. Barker's Physics.

OPTICS.—Radiant Energy, Photometry, Lenses and Mirrors, Optical Instruments. *Electricity and Magnetism.* Electrostatics, Magnetism, Thermal, Chemical and Magnetic, Relations of the Electric Current, Electrodynamics. Three times a week during the second term. Barker's Physics.

PHYSICAL LABORATORY.—Measurements of Length, Mass Time, Specific Gravity, Elasticity and Friction. Six hours a week during the second term of the C. E. course. Exercises from Sabine's and Stewart and Gee's Laboratory Guides.

SENIOR CLASS.

DYNAMO MACHINERY.—Lectures based on Thompson's Dynamo Machinery. Twice a week during the first term.

APPLIED ELECTRICITY.—Telegraph and Telephone Circuits, Arc and Incandescent Electric Light Wiring, Electricity Applied to Mining. Two lectures a week during the second term.

PHYSICAL LABORATORY.—Measurements in *Heat*, Calorimetry, Coefficients of Expansion, Conduction and Radiation. *Light*, Focal Length of Lenses, Curvature, Wave Length, Photometry, Spectroscopy. *Electricity*, Battery Current, E. M. F. and Resistance, Electrolysis. Exercises from Stewart and Gee's, Sabine's and Kohlrausch's Laboratory Guides. Six hours a week during the first term.

PHYSICAL LABORATORY.—Electrical measurements, Characteristic Curves and Efficiency Tests of Dynamos and Motors, Testing Insulation Resistance of Telegraph, Telephone and Electric Lighting Circuits, Testing and Calibrating Ammeters and Voltmeters, Design and Construction of Electro-magnets, Electro-metallurgy, Indicator diagrams and boiler tests. Six hours a week during the second term.

SPECIAL CLASS.

ELECTRICITY AND MAGNETISM.—Thompson's Lessons in Electricity, supplemented by lectures two times a week during the first term. Slingo and Brooker's Electrical Engineering two times a week during the second term.

PHYSICAL LABORATORY.—Electrical measurements, care and management of Dynamos and Motors. Three hours a week throughout the year.

Modern Languages.

The great quantity and worth of the technical literature in the French and German languages, added to their value as elements of liberal culture, makes at least a reading knowledge of them a highly desirable part of an Engineer's education. German is required in course III, while the choice of French or German is permitted in courses I and II.

The instruction in each language is designed to present the grammatical structure and the pronunciation of the tongue, to give some acquaintance with the masterpieces of its literature, and to confer such facility in translation as will enable the student to read with ease the language in both its literary and its scientific uses.

GERMAN.

MR. WILKINS.

First Year.—Introductory lessons on pronunciation and German script, Collar's Shorter Eysenbach, Joynes Reader, Anderson's Maerchen. Five times per week during the first term and thrice per week thereafter.

Second Year.—Grammar and Composition, Schiller's "William Tell," Lessing's "Nathan der Weise," Goethe's "Reinecke Fuchs," and selections from other German authors.

During the second term of this year the students in Scientific German read Hodge's Course in Scientific German. They will also be required to do parallel reading in the current scientific magazines and standard scientific works.

FRENCH.

PROF. RICHARDS.

First Year.—Otto's Grammar and Reader, "Choix de Contes" (Daudet), "Un Philosophe sous les Toits" (Souvestre), "L'Avare" (Moliere).

Second Year.—Grammar (continued), original exercises, Racine's "Phedre,," "Le Roman d'un Jeune Homme Pauvre" (Feuillet), "L'Abbe Constantin" (Halevy), Marie's Histoire des Sciences" or some scientific work in French.

Parallel reading, outside of that done in class, will be assigned and will constitute part of the work on which the student is examined.

Academic Course.

The Academic Course is maintained in compliance with an Act of the Legislature of 1885. It is intended to include that fundamental general culture which should in part precede and in part accompany specifically technical training—to present a liberal discipline valuable in any career. To those contemplating a professional course, here or elsewhere, who have not laid this foundation; to teachers who desire better equipment for their work, and to any others whose wants it may suffice, this course is offered. As will be seen, studies are offered in English, History, Political Economy, Logic, Mathematics, German, French, and the Natural Sciences.

To enter upon this course a knowledge of Arithmetic and English Grammar is required.

For its completion a Diploma of Graduation is conferred.

ACADEMIC COURSE OF STUDY.

FIRST YEAR.

FIRST TERM.			SECOND TERM.		
Hours of Recitation.	Studies.	Times per wk.	Hours of Recitation.	Studies.	Times per wk.
8:30 to 9:30	Physical Geography.....	3	8:30 to 9:30	Physiology and Hygiene	3
8:30 to 9:30	English—*Course I*... ...	2	8:30 to 9:30	General History.....	2
10:30 to 11:30	English—*Course I*.....	3	10:30 to 11:30	English—*Course II*.....	5
11:30 to 12:30	General History.	5	11:30 to 12:30	General History.....	3
2:00 to 3:00	Elementary Algebra....	5	2:00 to 3:00	Elementary Algebra....	5

SECOND YEAR.

8:30 to 9:30	English—*Course III*.....	3	8:30 to 9:30	English—*Course IV*	3
8:30 to 9:30	Elementary Physics....	2	9:30 to 10:30	Geometry (Solid).....	4
9:30 to 10:30	Elementary Physics.....	1			
9:30 to 10:30	Geometry (Plane).....	4	10:30 to 11:30	German or French.....	3
10:30 to 11:30	German or French.....	3	2:00 to 3:00	Civil Government.....	5

THIRD YEAR.

8:30 to 9:30	*French (2d year)... ...	2	8:30 to 9:30	French (2d year).... ...	2
9:30 to 10:30	English History.....	5	9:30 to 10:30	Political Economy.....	5
10:30 to 11:30	Elements of Psychology.	2	10:30 to 11:30	Elementary Chemistry..	3
11:30 to 12:30	*German (2d year).. ...	3	11:30 to 12:30	Logic.....	2
2:00 to 3:00	Higher Algebra.....	5	2:00 to 3:00	Higher Algebra.....	5
3:00 to 4:00	Zoology.....	5	3:00 to 4:00	*German (2 year).....	3
			3:00 to 4:00	Book-keeping (optional)	2

* Alternative with French.

ENGLISH.—In English four courses are offered, as follows:

Courses I and II.—The principles of written discourse; Letter-writing, and Essay. Written exercises are required daily from the belief that painstaking practice under proper

supervision is the best, if not the only, means of acquiring facility in the use of good English.

Classes in these courses meet five times a week throughout the year.

Text-Book.—Outlines of Rhetoric by Genung.

Courses III and IV.—The History of English Literature from its beginning to the present. It is thought that a thorough knowledge of a few of our great writers is better than a slight knowledge of many. Students are, therefore, required to make a special study of the life, character, and masterpieces of Chaucer, Shakspeare, and such other representative authors as the time will admit. Every effort will be made to have the student acquire the ready use of good English, and to that end biographies, essays, reviews, criticisms, etc., will be required weekly. The Library is supplied with all the books of reference necessary to make these courses both interesting and instructive. Classes meet three times a week throughout the year.

Text-Book.—Shaw's History of English and American Literature. Other books will be required as the classes progress.

MATHEMATICS.—A thorough knowledge of Elementary Algebra and Geometry is an essential requisite of a general education, as well as for entrance into higher scientific courses.

Two years are devoted to Algebra and one to Geometry. In Algebra, the course begins with the fundamental operations and extends through Quadratic Equations and the progressions. The class in Geometry completes the usual course in old Geometry, Plane and Solid.

Text-Books.—Algebra. First year—Wells' Academic Algebra. Second year—Wells' University Algebra, Wells' Plane and Solid Geometry.

GENERAL HISTORY.—It is desirable that the student have as thorough knowledge as possible of Ancient, Mediæval and Modern History. For this reason, the course here offered extends throughout the entire year. Special attention will be given to the growth and development of France, Germany and other modern nations of Europe. Students will be required to make constant use of the books of reference on History, found in the Library.

Text-Book.—Meyer's General History.

ENGLISH HISTORY.—An effort will be made to present clearly and concisely the main facts in the History of England from the Roman conquest to the present time. The growth of the political liberties of the people, the changes in social condition, and the advance in literature and arts will be shown as clearly as possible.

Text-Book.—Montgomery's "The Leading Facts of English History."

FRENCH OR GERMAN.—Students completing the Academic course are required to take two years of German or French. For information concerning the courses offered in these subjects see MODERN LANGUAGES on page 57 of this catalogue.

PHYSICS.—In the course, the object constantly held in view is to present simply and plainly the fundamental truths of Natural Philosophy. The subjects of properties of matter, sound, light, heat, and electricity are introduced upon a scientific basis and are illustrated throughout the course by experiments. The department is supplied with apparatus of all kinds necessary for this purpose.

Text-Book.—Elements of Physics by Carhart and Chute.

ELEMENTARY INORGANIC CHEMISTRY.—In this course careful detailed instruction is given in the elementary principles of Chemistry, with a description of the most important elements and compounds, and the formation and solution of chemical equations.

PHYSIOLOGY.—It is aimed to make the instruction in this branch as thorough and practical as possible, and to lead the student to obey the injunction "Know Thyself."

Text-Book.—Martin's Human Body.

PHYSICAL GEOGRAPHY.—The comprehensive nature of this study does not admit of its being treated in all its phases in the short time allotted to it.

The course will be principally descriptive, though the presentation of the scientific principles involved will be as thorough and complete as practicable, the design being to make this study serve as an introduction to the other natural sciences taken up later in the course.

Text-Book.—To be determined.

CIVIL GOVERNMENT.—The text-book now in use (Young's Class Book) gives an analysis of the Constitution of the United States, presents a comparative view of the different State Governments, treats of County and Township organizations, and affords an acquaintance with such principles of law as are involved in ordinary business transactions. Special attention will be given to the Government of the State of Missouri.

POLITICAL ECONOMY.—All that is attempted in this subject, is to present in plain and simple form the elementary principles of Political Economy. The main topics are treated, the fundamental principles studied and discussed, but no attempt is made to inculcate any particular economic doctrine.

Text-Book.—Laughlin's Elements of Political Economy.

PSYCHOLOGY.—The aim in this study is to place before the student, in as simple and compact form as possible, a few of the leading facts connected with the human mind—its

powers, its capabilities, its growth, and some of the ways by which powers may be strengthened and cultivated.

Text-Book.—Hewett's Elements of Psychology.

Logic.—This study is intended to supplement that of Psychology. In the latter we have the analysis of the intellectual powers, in the former an investigation of the laws of correct reasoning.

Text-Book.—Gilmore's Outlines of Logic.

Book-Keeping.—This study is not required, but will be taught upon the application of at least five students for instruction therein. The course comprises principally Double Entry. Various kinds of business are represented, and all the modern conveniences and auxilaries are explained and used. The student is required to finish at least six different sets of books. Those who complete these before the end of the term will be furnished with abundant material for further practice.

Grounds, Buildings, and Equipment.

The grounds of the School of Mines are situated in the highest part of the town of Rolla, and are somewhat over twenty acres in extent. The recent purchase of the lot intervening between the Campus proper and the "Park" has united the holdings of the school into a single continuous tract. The buildings, which are all substantial brick structures, are: the Main Building, Chemical Laboratory, Mess Club House, and the Mining and Metallurgical Laboratory, which is now in process of erection, and will be occupied at the beginning of the next session.

Engineering Equipment.

The equipment for Field Practice includes; a Heller and Brightly transit with solar attachments; a Gurley Construction transit; a plane table with stadia attachments; a Gurley Y Level; a Buff and Berger Y Level; a Gurley Solar Compass; a Gurley Vernier Compass; two Sextants; a Lock Level, with the necessary Level Rods, Chains, etc.

Tests of cement are made with a Riehle Bros.' U. S. Standard Cement Testing machine. A Steam Calorimeter, a Thompson's Steam Engine Indicator, and a Dynamometer are used in the instruction in Steam Engineering.

The shop contains a Steam Engine, Metal Lathe, Wood Lathe, Benches for wood-work, and individual sets of hand tools.

Chemical Laboratory.

The Chemical Laboratory has been in use eight years, and has been found satisfactory. It was planned and built solely with reference to the work in the school, and the entire building is used by the Chemical Department.

In this building there are the following departments. The quantitative laboratory, the qualitative laboratory, professor's laboratory, lecture room, assay laboratory and weighing room, a quantitative and qualitative evaporating room, preparation room, supply room and two basement rooms, furnishing accommodations for thirty-six students at a time.

In the construction of this Laboratory no pains were spared to make the Assay Laboratory complete in every respect. It is located on the first floor, and not in the basement. The reduction furnace, as well as the muffle furnaces, are of the newest and best. Two large muffle furnaces, two smaller ones, one gas furnace, an ore crusher, pulverizing plate, ore and assay balances, with other facilities, are provided for the use of students.

Facilities for securing heat, light and ventilation are excellent; ample provision is also made for carrying off foul and dangerous gases. All parts of the building are well equipped; nothing has been left undone to make this laboratory one of the most complete in the country. Gas and water are supplied to each table.

The laboratory contains, in addition to a large assortment of the apparatus regularly and ordinarily met with in well equipped institutions three of Becker's Analytical Balances, Contact and Reflecting Goniometers, and other valuable pieces of apparatus for work and research. Four new balances and other apparatus have recently been ordered. The Laboratory is open to the students for work daily from 8 A. M. to 5:30 P. M.

Physical Laboratory.

The Physical Laboratory occupies three rooms in the main building and is supplied with standard measuring instruments to which additions are constantly being made. Among the additions of the past year may be mentioned, a Westinghouse Alternator with transformer, Alternate current meter, A. C. ammeter and A. C. voltmeter, a Prony brake, Steam

Calorimeter and Steam Engine Indicator, added to the dynamo room: Weston's Milli-voltmeter and Centi-ampere meter, Queen's D'Arsonval Galvanometer and Portable Testing Set added to the testing room; a Geneva Society Spherometer and duplicates of the Harvard Physical Laboratory apparatus made by Gillis and Gleeson added to the general laboratory.

The department received a 300 C. P. Packard "Mogul" lamp with the compliments of the New York and Ohio Company.

A workshop connected with the laboratory is supplied with the necessary tools, and the student is encouraged in designing and making with his own hands any apparatus that he may require.

Equipment in Mineralogy and Geology.

This includes a representative collection of 800 specimens of minerals for class use; 200 specimens of rocks; 150 specimens of typical fossils; a large collection illustrating metallurgical processes; a collection of 500 specimens of ore from the World's Fair. To this, additions are being made from time to time. This material will be greatly augmented by the acquisition in 1895 of the entire Missouri Mineral Exhibit at the late World's Fair, which, by act of the last legislature, after remaining in the St. Louis Exposition for two years, is to come to the School of Mines. A full equipment for Geological surveys has been procured. Ample facilities for blow pipe work are provided, and the Petrographic Laboratory is fitted with the needed microscopes, sectioning machines, etc.

Mining and Metallurgical Laboratory.

The last legislature appropriated $25,000 for building and equipping a Mining and Metallurgical Laboratory. The building is now in process of construction, and will be completed and equipped by September 1. Its plan has been described in the Director's report p. 6.

The three divisions—Instruction Department, Milling Room and Power Plant—are distinct though under one roof. The Instruction department contains a Lecture room, Mineralogy Room, Reference Reading Room, Supply Room, Chemical Analysis Room, Office and Experimenting Laboratory on the first floor; the second floor contains Draughting room, a Petrography room, Photographic and Blue Print room and Storage room. The Milling room contains the ore dressing and Metallurgical plant. The machinery will be of full working size, and will include crushers, rolls, elevators, jigs, sand and slime concentrators, hydraulic and mechanical classifiers, tanks, pumps, etc. Cupola, regenerative, and crucible furnaces, gas producer, experimenting furnaces, blowers, etc., will form the basis for a metallurgical plant. The design and purpose of this Laboratory is practical in character and the methods used and management approach, as nearly as practicable, those employed in business.

The power plant has two tubular boilers supplying steam for 50 H. P. automatic engine; it contains also fuel bins, repair benches, dynamo, and necessary supplies. The building is lighted by electricity and gas and warmed by the hot water system.

Library.

The Library contains 3,000 volumes. Good collections of works upon Engineering, Mathematics, Chemistry, Physics, Mining and Metallurgy afford to students in these departments an opportunity to pursue an extended course of reading in connection with their class work. The Library also contains the standard works in English and American Poetry, Fiction,

Biography and History. It is well provided with encyclopædias and works for general reference. The Library is open and in charge of the Librarian from 8:30 A. M. to 12:30 P. M. and from 2 to 4 P. M. During these hours books may be taken out and the Library room used for reading and study. The following periodicals for the current year are found on the reading tables of the Library:

American Chemical Journal,
American Journal of Science,
American Geologist,
American Machinist,
Annals of Mathematics,
Century Magazine,
Chemical News (London),
Colliery Engineer,
Cosmopolitan,
Electrical Engineer,
Electrical World,
Engineering News,
Forum,
Harper's Monthly,
Harper's Weekly,
Illustrated London News,
Iron Age,
Journal of the American Chemical Society,
Ladies' Home Journal,
Life,
Literary Digest,
Magazine of American History,
Mining Review,
Nation,
North American Review,
Engineering Magazine,
Engineering and Mining Journal,
Physical Education,
Popular Science Monthly,
Railroad and Engineering Journal,
Scribner's Magazine,
University Argus.

Mess Club House.

The "Club House," a three story brick building of pleasing architecture, which has been in use only four years, has recently been thoroughly repaired, cleaned, papered, and put into the best of order. It is in charge of a caterer, elected by the Executive Committee of the School of Mines. Students occupying it form themselves into a "Mess Club," which is managed by a committee of their own number elected by themselves, in accordance with such rules as may be adopted by the Club and approved by the Director of the School. No charge is made for room rent, but in order to engage quarters each applicant must deposit with the Treasurer of the School of Mines five dollars ($5.00), which shall be held as a contingent fund to pay for any damages for which the depositor may be responsible—the unconsumed portion of such fund being

returned to him at the end of the session. Choice of rooms will be permitted in the order in which such deposits are received.

The *maximum* cost of board (including fuel, lights, etc.,) will be $12 a month. Of this sum $1 will be set aside for caterer's salary and $1 for fuel and repairs; beyond this the student shall pay only the actual cost of provisions and attendance and whatever sums may remain unexpended in the Club's treasury at the end of each term shall be then distributed equally among its original contributors.

Students furnish blankets, sheets, pillow cases, towels and napkins.

As the accommodations are limited, early application is advised.

General Information.

EXPENSES.

The School of Mines is endowed and supported by the state for the benefit of its sons, and seeks to offer to them its instructions at the lowest possible cost. It is believed that nowhere else in this country can equal advantages be had at such slight expense. The only fixed general charges are an entrance fee of $10, payable whenever the student may enter, and a library fee of $2 a term, payable at the beginning of each term. There is no charge for tuition. Students in the laboratories pay for apparatus damaged or destroyed; those in the chemical laboratory pay also for gas and fuel consumed and for chemicals used. To make this last item as small as possible the School buys such supplies at wholesale rates and

issues them to students as they are needed at corresponding prices. To cover bills arising from these sources students in Qualitative Analysis deposit upon entrance $10; those in Quantitative Analysis $15. These deposits must be renewed if at any time exhausted; at the end of the session whatever sum may remain to the credit of the depositor is returned to him.

No distinction in admission nor in charges is made between residents of this state and of other states.

Board, including lodging, meals, fuel and lights, may be had in the Mess Club for not over $12 a month; in private families for from $12 to $15; at the hotels for from $15 to $20. Washing costs from $1 to $1.50 per month.

Subjoined is an estimate of the necessary expenses for the school year:

	Moderate.	Ample.
Entrance and Library Fees	$ 14.00	$ 14.00
Books, Stationery, Chemicals	15.00	50.00
Board, fuel, lights, washing	117.00	144.00
Total	$146.00	$208.00

EXEMPTION FROM FEES.

It is ordered by the Board that "all regular graduates of any department of the University, and every regular graduate of the Normal Schools established by law within the State, and the graduates of all other regularly chartered Literary and Scientific Colleges in this State with regular classes established therein, that are authorized by law to confer degrees and to grant diplomas to their students, shall be entitled to take *graduate* work in all the departments of the State University, including the School of Mines at Rolla, as Post-Graduates, free of the payment of entrance fees."

By a similar resolution, teachers in the Public Schools of Missouri will, *during the second term*, be admitted without the payment of any entrance fee. This privilege is granted to

enable teachers, after their schools are closed, to utilize their time in self-improvement. The school looks for its reward to the eventual improvement of our entering students.

TERMS AND VACATIONS.

The college year is divided into two terms of nineteen weeks each. The first term begins on the third Tuesday in September, and ends about February 1. A ten days' vacation is given during the holidays to include Christmas and New Year. There is no interval between the ending of the first term and the beginning of the second. The second term ends on Commencement Day, which is the second Thursday in June. The summer vacation extends from Commencement to the third Tuesday in September.

EXAMINATIONS.

In most of the classes there are daily oral examinations. Occasional written examinations on portions of subjects are held. These are designed to give the students a review, to practice him in the writing of examination papers, and to enlighten the professor as to the progress of his class. From these sources the monthly grades are determined. At the end of each term, searching written examinations on all the matter studied during the term are held. The marks gotten in these combined with the average monthly grades, determine the "term grades." To pass, 75 per cent. is required.

MONTHLY REPORTS.

Regular monthly reports are sent to the parents or guardian of each student, showing the student's grade in scholarship for the month and giving such other information in regard to his progress, attendance, etc., as may be thought of interest. The attention of parents and guardians is particularly called to these reports.

DISCIPLINE.

The School of Mines has but two general rules: 1. Be a gentleman (or a lady). 2. Work. Students who violate either of these are requested to leave. Flagrant violations of them are punished by suspension or expulsion according to the nature of the offense.

STUDENTS' SOCIETIES.

Two literary societies are conducted—the "Philo" Literary Society by the young men, and the "Alpha" Club by the young women of the school. They hold weekly meetings for the purpose of improvement in debate, oratory and composition. The "Alpha" meets every Saturday afternoon and the "Philo" every Saturday evening.

This year a friend of the "Philo" Society has offered a gold medal to be awarded to the successful contestant in a debate which will occur at the society's celebration during Commencement Week.

In addition to these there are a "Mining Club," which meets every two weeks to discuss questions relating to Mining and Metallurgy; an "Electric Club," which also meets fortnightly to discuss electricity and its contemporaneous applications; and a "Teacher's Club," composed of teachers and others interested in pedagogics.

ATHLETICS.

Through the liberality of the Curators, an athletic field has been enclosed and graded for the benefit of the students. It furnishes ample space for base-ball, foot-ball and lawn tennis. An Athletic Association exists among the students and foot-ball and base-ball teams are in organization.

DEGREES.

UNTITLED DEGREES.

1. A Certificate of Proficiency is conferred on one who has attained the required standard in any of the following special courses: Short Course in Mining, Assaying, Surveying, Electricity, Geology and Mineralogy, Inorganic Chemistry and Mathematics (through the Calculus).

2. A Diploma of Graduation is conferred on one who has attained the required standard in any of the following departments: Mathematics, Physics, Analytical Chemistry, Engineering, Mining and Metallurgy and the Academic Course.

DEGREES WITH TITLES.

1. The degree of Bachelor of Science in Mining Engineering, Bachelor of Science in Civil Engineering, or Bachelor of Science in Chemistry and Metallurgy, will be conferred on one who has attained the required standard on all the subjects of instruction in Course I, Course II, or Course III.

2. The further degree of Engineer of Mines, Civil Engineer, or Metallurgical Engineer, will be conferred on one who, having previously graduated in Course I, Course II or Course III, has completed satisfactorily a year's post-graduate work in residence here, or who has had professional experience in a responsible position for not less than two years.

COMMENCEMENT.

The annual Commencement exercises are held in the Assembly Room on the morning of the final day of the session, the second Thursday in June. The exercises consist of the conferring of certificates, diplomas and degrees, the reading, when advisable, by the graduates, of abstracts of their theses,

and an address by some prominent speaker. At the last Commencement the addresses were delivered by the Hon. G. F. Rothwell, President of the Board of Curators, and Gov. Wm. J. Stone.

There were awarded the following:

CERTIFICATES OF PROFICIENCY.

Surveying.

Alexander, G. E.	Grove, C. D.	Thomas, W. S.
Cowen, H. C.	McMullin, R. W. Jr.	Torrence, L. C.
Dyer, T.	Reid, J. C.	
Gormly, S. J.	Spencer, H. G.	

General Chemistry.

Alexander, G. E.	Florreich, P.	Hogan, C. W., Jr.
Buskett, M. P	Gormly, S. J.	McMullin, R. W., Jr,
Cowen, H. C.	Henry, D. E.	Spencer, H. G.
Dwyer, E. P.		

Fire Assaying.

Alexander, G. E.	Dwyer, E. P.	Tyrrell, F. L.
DeLay, T. S.	Lewis, L. J.	

Mineralogy and Geology.

DeLay, T. S.	Dyer, T.	Spencer, C. B.
	Reid, J. C.	

Mathematics.

Millard, S. E.	Torrence, L. C.

Degrees.

Bachelor of Science (in General Course).

Mary Page Buskett - Subject of Thesis, Classification of Insects.

Bachelor of Science (in Civil Engineering).

Clifton Bates Spencer - - Subject of Thesis, Conic Machines.

Mining Engineer.

John Calum Reid - Subject of Thesis, The Cyanide Process for Gold.

Frank Lee Tyrrell (C. E., 1892) - - - - - - -
Subject of Thesis, The Russell Process for Gold and Silver.

IN CONCLUSION.

This catalogue is designed to answer all questions that would naturally suggest themselves to intending students. If, however, additional information is desired, the Director will, upon application, cheerfully furnish it.

The Director is desirous of obtaining an accurate and complete list of the positions held by alumni and their present addresses. He begs that each alumnus whom this may reach will forward to him before March 1, 1895, a brief outline of his career since graduation, the positions which he has filled, and his present occupation and address.

Catalogue of Students.

GRADUATES.

Buskett, Mary Page,..... Rolla.

UNDER-GRADUATES.

SENIOR CLASS.

Alexander, George Ernest,..... Maryville.
Dyer, Temple,..... Rolla.
Grove, Claude Devlin,..... Gallatin.
Herdman, George Walker,..... Neosho Falls, Kan.
Thomas, William Stephens,..... Bevier.

JUNIOR CLASS.

Buskett, Evans Walker, ... Rolla.
Dwyer, Edward,..... Joplin.
Florreich, Philip,..... St. Louis.
Gormly, Samuel James, ... Mt. Vernon, Ia.
Kirkham, John Edward,..... Strawn, Ill.
McMullin, Richard Willie,..... Hillsboro.
Spencer, Herbert Galen..... Joplin.

SOPHOMORE CLASS.

Allen, Charles Keyes,..... Mexico.
Donnelly, Arthur Thomas,..... Lebanon.
Eardley, Albert Edwin, ... Carrizo Springs, Texas.
Fleck, Ward Isaiah,..... Scotland.
Greenzweight, Alpheus Harmon,..... Como, Colo.
Iijima, Zentaro,..... Saitamaken, Japan.
Offen, Alwin,..... Granite, Mont.
Suppan, Leo Richard August..... St. Louis.
Weissgerber, Otto,..... Lebanon.
Zelch, John Albert,..... Clayton.

FRESHMAN CLASS.

Anderson, Perry Barton,.....Neosho.
Binns, Forest John,.....Princeton, Ky.
Cameron, John Simpson,.....McAlester, I. T.
Campbell, Eugene,.....Rolla.
Dean, George Walter,.....Rolla.
Ebbinghaus, George William,.....Erie.
Fay, Charles Joseph,.....Anaheim, Cal.
Gilstrap, James Wilson,.....Neosho.
Hallet, Robert Leland,.....Chicago, Ill.
Kersting, Felix,.....St. Louis.
Kidd, George Carl,.....Nebraska City, Neb.
Klinge, Carl Albert,.....St. Louis.
Knapp, Theron Lorenzo,.....Toledo, Ia.
Larsh, Paul Armstrong,.....Nebraska City, Neb.
Lunbeck, George Albert,.....Holden.
Mitchell, Walter,.....Rolla.
Nicholson, Maurice William Steele,.....Kansas City, Kan.
Oatley, John Arthur,.....Rolla.
Robertson, George Gordon,.....Cuba.
Rogers, John,.....Bevier.
Sinclair, Albert Kent,.....Pierce City.
Smith, George Washington,.....Rockford, Ill.
Terrell, Arthur Davis,.....Holden.
Thompson, Frederick Lewis,.....Rolla.
Wendt, Francis Eugene,.....St. James.
Wood, Arthur Edward,.....Rolla.

SPECIAL STUDENTS.

Bertrand, Louis,.....Conway, Ia.
Clark, Charles Frederick,.....Lebanon.
Cleino, Henry,.....Rolla.
Cox, John Charles,.....Aspen, Colo.
Cox, William Rowland,.....Aspen, Colo.
Donnan, Lyman Lee,.....Cooney, N. M.
Donnelly, Sophia Mary,.....Lebanon.
Dulin, Robert Smith,.....Liberty.
Fox, Homer Hastings,.....St. Louis.
Harris, Walter Bibb,.....Melbourne, Ark.
Herzinger, John.....Granite, Mont.
Jones, Harry Irving,.....St. Louis.
Wickham, Alfred Cunningham,.....Jefferson City.

ACADEMIC STUDENTS.

Bland, Harry Osmund, ... Rolla.
Boas, Selma Fannie, ... Rolla.
Bonebrake, Harry, ... Rolla.
Brucher, Edith, ... Rolla.
Burgher, Sylvia, ... Rolla.
Cleino, Charles Conrad, ... Rolla.
Coffman, Lena, ... Rolla.
Deegan, Agnes Julian ..... Rolla.
Denison, William Thomas, ... Beulah
Donahoe, William Patrick, ... Rolla.
Gillespie, Lida, ... Rolla.
Godwin, Annie Gill ..... Rolla.
Gough, Edward Perry, ... Rolla.
Hawkins, William Carrol, ... Brumly.
Heimberger, Emma, ... Rolla.
Herndon, John Arthur, ... Lebanon.
Holman, Florence Isabel, ... Lebanon.
Huffman, Charles Edgar, ... Rolla.
Jamison, Claude Eagan, ... Rolla.
Jones, Mary Elsie, ... Rolla.
Knapp, Harlan Burr, ... Toledo, Ia.
Laun, Nora, ... Norman.
Lenox, Marion, ... St. James.
Lepper, Anna May, ... Rolla.
Livingstone, Archibald Armstrong, ... Elk Prairie.
McCaw, Jean Isabel, ... Rolla.
McCaw, Norris Elbert, ... Rolla.
McCracken, John Albert, ... Rolla.
McCracken, Lucy Ellen, ... Rolla.
Millard, Linna, ... Rolla.
Millsap, Emmett, ... Lebanon.
Moll, Oliver Richard, ... St. Louis.
Moll, Walter Herman, ... St. Louis.
Morris, Della Florence, ... Rolla.
Morris, Lola Jane, ... Rolla.
Petraglio, Ama, ... Rolla.
Powell Anna Elizabeth, ... Rolla.
Richardson, Grace Sarepta, ... Rolla.
Rineheart, George Washington, ... Red Bird.
Rolufs, Rulof Theodore, ... Rolla.

Sappenfield, Olive,.....Rolla.
Sappenfield, Virgil,.....Rolla.
Shaw, Olive Helen,.....Rolla.
Shields, John Alvah,.....Phillipsburg.
Smith, Joseph Henderson,.....Rolla.
Soest, Adele.....Rolla.
Southgate, Margaret Barron,.....Rolla.
Spearman, Aulta,.....Brumly.
Stephenson, Lulu Elizabeth,.....Rolla.
Strobach, Carl Fred,.....Rolla.
Todd, Dora Isabelle,.....Newberg.
Via, Jessie Miller,.....Rolla.
Vocke, Oscar,.....St. Louis.
Walker, Emma Caroline,.....Rolla.
Walker, Jennie,.....Rolla.
Walker, Mary Elizabeth,.....Rolla.
Weisenbach, Addie Marguerite,.....Rolla.
Wilkins, Elinor Matilda,.....Rolla.
Wilson, Thomas Val.....Dixon.

SUMMARY BY STATES.

Missouri	98
Iowa	4
Colorado	3
Illinois	3
Kansas	2
Nebraska	2
Arkansas	1
California	1
Indian Territory	1
Kentucky	1
Montana	2
New Mexico	1
Texas	1
Japan	1
Total	121

Graduates.

1874.

Gustavus A. Duncan, C. E.—Mining and Mine Examination. Malden, Mass.

*John Holt Gill, C. E.—Died June 14, 1882.

John Wallace Pack, M. E.—Assayer U. S. Mint, San Francisco, Cal.

1875.

*Francis J. Deegan, C. E.—Died, 1892.

Almon Warner Hare, M. E.—Chemist and Assayer, P. O. Box 318, Aspen, Colo.

1876.

Cyrus H. Emerson, C. E.

Oscar E. Garvens, M. E.

John D. Greason, M. E.

John Edward McGrath, C. E., M. A.—Assistant U. S. Coast Survey, Sitka, Alaska.

William C. Minger, M. E.—Chemist and Assayer, Georgetown, Colo.

1877.

A. H. Ohmann-Dumesnil, M. E., A. M., M. D.—Physician and Author, 1, N. Broadway, St. Louis, Mo.

Thomas H, Milsaps, C. E.

James Alexander Pack, M. E.—Mining Engineer, DeLamar, Idaho.

1878.

William Y. Bean, C. E.

Wilton Rutherford Brown, M. E.—Died 1893.

Lindsey L. Cappede, C. E.—Died, 1885.

Lee R. Grabill, M. E.

1879.

Rudolph C. Hoyer, C. E.—Draughtsman, U. S. Engineer's Office, Memphis, Tenn.

Charles F. Winters, M. E.—Teller, Los Angeles, Nat. Bank, 129 N. Olive St., Los Angeles, Cal.

1880.

Arthur Carson, M. E.—Chemist and Assayer, Butte City, Mont.

Lorin X. Smith, M. E., C. E.—Engineer for Granite Mountain Mine, Phillipsburg, Mont.

1881.

Edward B. Summers, C. E.—With King Iron Bridge Co., 1625, Madison Ave., New York.

Walter W. Wishon, M. E.—Chief Chemist, Montana Ore Purchasing Co., 41 E. Park St., Butte City, Mont.

1882.

Frank W. Gibb, C. E., M. E.—Mining Engineer and Chemist, Member American Institute Mining Engineers, Little Rock, Ark.

W. R. Painter, C. E.—Attorney-at-Law, Carrollton, Mo.

Beaureguard Ross, M. E.—Editor *The Sun* and Postmaster, Cameron, Mo.

Ashnah B. Schrantz, C. E.

Herman Neff Van Devander, C. E.—Secretary and Treasurer North Georgia Mining Co., Cedartown, Ga.

1883.

Floyd Davis, C. E., M. E., Ph. D.—President New Mexico School of Mines, Socorco, N. M.

1884.

Curtis Alexander, C. E., M. E.—Chief Assayer of Consolidated Kansas City Smelting and Refining Co., Argentine, Kan.

William M. Claypool, C. E., M. E.

Arthur Neustaedter, M. E.—Chemist and Assayer, Butte City, Mont.

Philip C. Gallagher, M. E.—Miner, Creede, Colo.

Frank W. Wilson, C. E.—Contracting Agent King Iron Bridge Co., 18 Broadway, New York, N. Y.

1885.

John R. D. Owen, M. E.—Died.

Philip R. Van Frank, M. E.—Transitman U. S. River Commission, Little Rock, Arkansas.

Fremont W. Wilson, C. E.—Civil Engineer, Middlesborough, Ky.

1886.

Jay Cullens, C. E.

James E. Fulcher, C. E.—Professor Natural Science and Mathematics, McCune College, Louisiana, Mo.

Justo S. Martinez, M. E.

1887.

George W. Cole, C. E.—Second Lieutenant Seventh Cavalry, U. S. A., Ft. Riley, Kan.

Oscar Lachmund, M. E.—Assayer and Chemist for Idaho Sampling Works, Idaho Springs, Colo.

W. Merritt Yeater, M. E.—Civil Engineer, Sedalia, Mo.

George B. Miles, C. E.—With St. Louis Bridge and Iron Co., St. Louis, Mo.

1890.

George Reginald Dean, C. E.—See 1891.

1891.

George Reginald Dean, C. E., B. S. C.—Late Professor of Mathematics in Coe College, Iowa, and assistant in Observatory, University of Virginia, now at Kansas City, Mo.

Sallie Elizabeth Millard, B. S. C.—First Assistant in Vichy Normal and Business Institute, Vichy, Mo.

Frank H. Seamon, M. E.—Chemist and Assayer Vacas Mining and Smelting Co., Mina de Vacas, Estado de Durango, Mexico.

Arthur J. Stewart, B. Sc.—Assistant Superintendent Notolino Mining Co., La Noria, State of Zacatecas, Mexico.

1892.

Daniel C. Jackling, B. Sc.—Chemist and Assayer, Cripple Creek, Colo.

Edward Mackay Johnson, B. Sc.—With Kansas City Smelting and Refining Co., Argentine, Kan.

Fayette A. Jones, C. E., M. E.—Late Mining Engineer and Assayer for Union Mining Co., Phœnix, Ariz., now engaged in city engineering, Independence, Mo.

Frank L. Tyrrell, C. E.—See 1893.

1893.

Frank L. Tyrrell, C. E., M. E.—In assaying department of the Consolidated Kansas City Smelting and Refining Co., Argentine, Kan.

Clifton Bates Spencer, B. S.—Student at Cornell University, Ithaca, N. Y.

John Calum Reid, M. E.—Draughtsman in office of H. H. Hohenschild, Architect, Rolla, Mo.

Mary Page Buskett, B. S.—Graduate Student Missouri School of Mines, Rolla, Mo.

SOME OTHERS WHO COMPLETED PARTIAL COURSES.

James L. Buskett (1886).—Assayer and Chemist for Glass Bros., Boulder, Mont.

Louis W. Buskett (1889).—Assayer, Rimini, Mont.

William Patton Hilman, (1891).—Professor of Mathematics, State School of Mines, Rapid City, S. D.

Parker Lowe (1891).—Transitman Mississippi River Commission, St. Louis, Mo.

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"WORK IS VICTORY."

—*Emerson.*

Twenty-Fourth Annual Catalogue

of the

School of Mines and Metallurgy

of the

University of the State of Missouri,

Rolla, Missouri.

1895.

MEKEEL'S PRINTING ESTABLISHMENT,
ST. LOUIS, MO.

Calendar.

1895.

June 13, Thursday, 10 A. M. ..... Annual Commencement.
September 16, Monday, 10 A. M. ..... Entrance Examination.
September 17, Tuesday ..... First Term Begins.
November 28, Thursday ..... Thanksgiving Holiday.
December 24, Monday ..... Christmas Holidays Begin.

1896.

January 2, Thursday ..... Exercises Resumed.
January 27, Monday ..... Mid-Year Examinations Begin.
February 4, Tuesday ..... Second Term Begins.
February 22, Saturday ..... Washington's Birthday Holiday.
June 1, Monday ..... Final Examinations Begin.
June 9 Tuesday ..... Final Examinations Close.
June 11, Thursday, 10 A. M. ..... Annual Commencement.

Introductory Statement.

Instead of printing in full the Director's Report to the Board of Curators, a brief statement, designed to inform the friends of the School of its progress, is here made.

The first important change of the past year was the discontinuance of the lower work of the Academic Course and the institution of written examinations for entrance. It was expected that this would reduce the Academic attendance, and such has been the result. The attendance of technical students, however, during the past year has been larger than ever before in the history of the School, and a larger number of men than ever previously have been engaged in advanced work. For the first time since the School was established the Chemical Laboratory and the Drawing Room have both had their capacities fully utilized. That the liberality of Missouri in admitting applicants from other States upon the same basis with her own sons is appreciated, is shown by the fact that our students during the year 1894-5 came from thirteen States and two foreign countries (Canada and Japan).

In the revision of the courses last year more effective work in English was made a feature of the Freshman year, a modern language was required in each of the courses, and the course in Mining and Metallurgy received the development made possible by the establishment of a special Chair for those subjects. The strengthening of the courses has been continued with the present year by putting Plane Trigonometry into the Freshman year and advancing the Pure

Mathematics throughout by one semester. The time thus gained in the Senior year is devoted to an increased amount of purely technical work.

The past year has been prominently marked by the completion of the Mining and Metallurgical Laboratory, which is described on page 60. This building and its equipment add a highly important and valuable means of instruction in the subjects to which they pertain. They give the School advantages in this line which are almost unique.

The 38th General Assembly has made, in addition to an appropriation for maintenance, special appropriations of $3,500 for improving the campus and grounds and $2,500 for remodeling and equipping certain portions of the Chemical Laboratory. It is expected that our funds will permit needed additions to the other laboratories.

In the content of its courses, in its facilities for instruction, in its technical attendance, the School has in the past few years made a steady advance; the co-operation of its friends in securing the continuance of this progress is invited.

Club House.

Chemical Laboratory

Board of Curators

of the

University of the State of Missouri.

Term expires January 1, 1895. *

Gardiner Lathrop	Kansas City.
B. R. Cauthorn	Mexico.
M. E. Benton	Neosho.

Term expires January 1, 1897.

C. M. Woodward	St. Louis.
Nat. M. Shelton	Lancaster.
W. M. Eads	Carrollton.

Term expires January 1, 1899.

R. B. Oliver	Jackson.
G. B. Rollins	Columbia.
C. C. Bland †	Rolla.

OFFICERS OF THE BOARD.

C. M. Woodward	President.
Nat. M. Shelton	Vice-President.
J. G. Babb	Secretary.
R. B. Price	Treasurer.

* Under the statutes members of the Board remain in office until their successors are appointed and qualify.

† Resigned, March, 1895.

Executive Committee.

of the

School of Mines and Metallurgy.

R. B. Oliver - - - - - - Jackson.
M. E. Benton - - - - - - Neosho.
W. M. Eads - - - - - - Carrollton.

OFFICERS OF THE COMMITTEE.

R. B. Oliver - - - - - - Chairman.
M. F. Faulkner, - - - - - - Secretary.
D. W. Malcolm - - - - - - Treasurer.

Faculty.

Richard H. Jesse, LL. D., - *President of the University.*

Walter Buck Richards, M. A., (University of Virginia.)
Director and Professor of Mathematics.

Elmo G. Harris, C. E., (University of Virginia.)
Professor of Engineering.

William H. Seamon, B. Sc. A., (University of Virginia.)
Professor of Chemistry.

Courtenay DeKalb, *Professor of Mining and Metallurgy.*

Arthur H. Timmerman, B. S., M. M. E., (Cornell University.)
Professor of Physics.

Paul J. Wilkins, B. S., (Michigan A. and M. College.)
Instructor in Academic Department.

Thomas L. Rubey, A. M., (Missouri State University.)
Secretary and Instructor in Academic Department.

Thomas Grayson Poats, (Grad., Miller School of Virginia.)
Instructor in Shop Work and Drawing.

William S. Thomas, B. S., (Missouri School of Mines)
Assistant in Chemical Laboratory.

Administrative Officers.

RICHARD H. JESSE,
President of the University.

WALTER B. RICHARDS,
Director of the School of Mines.

THOMAS L. RUBEY,
Librarian and Secretary of the Faculty.

History.

In 1870 the General Assembly of Missouri in accepting the donation of land for educational purposes made by the general government through Act of Congress, approved July 2, 1862, established an Agricultural and Mechanical College and a School of Mines and Metallurgy. The design of these institutions is set forth in the following language :

Objects of these Colleges.—The leading objects of said colleges shall be to teach such branches as are related to agriculture and the mechanic arts and mining, including military tactics, and without excluding other scientific and classical studies, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. (R. S. 1889, Sec. 8739.)

The Agricultural and Mechanical College was located in Boone County ; the School of Mines and Metallurgy was to be located in that county of Southern Missouri which should offer the greatest inducements for such location. A commission was appointed to receive and pass upon proposals looking to this, and after mature investigation and deliberation pronounced in favor of Phelps county. Here in the next year (1871), the School of Mines began its active existence.

The statutes fix the *status* of the School as one of the colleges of the State University. Its affairs are immediately under the supervision of an Executive Committee, consisting of three members of the University Board of Curators elected by that body.

The need of a general culture as a foundation and accompaniment of specifically technical training and the prevailing

absence of facilities for gaining this from the reach of the intended beneficiaries of the institution led to the establishment in 1885 of an Academic Course in compliance with the following Act of Assembly:

Academic Course of Study, etc.—That the obligations of the State to the general government, assumed by the acceptance of the land grant of July 2, 1862, may be more fully discharged, and in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life, the Board of Curators of the State University shall prescribe and adopt a liberal Academic Course of Study to be taught in the College of Mines and Metallurgy, located at Rolla, in addition to the courses now taught in said school, and may confer the degree of Bachelor of Science upon all students who shall complete said course in said school to the satisfaction of the faculty thereof. (R. S., Sec. 8740.)

The School of Mines is organized and conducted with a view to subserving, as efficiently as possible, the ends set forth in the legislative enactments in reference to it.

Finances.

The proceeds from the sale of the public lands, the grant of which has been referred to, amounts to $332,000, which is invested in State certificates of indebtedness bearing 5 per cent. interest. The School of Mines receives one-fourth of the yearly income thus accruing. By an act of Congress approved August 30th, 1890, commonly known as the "Morrill Bill," the general government donated to each State and

territory, maintaining a college or colleges in accordance with the act of July 2d, 1862, $15,000 for the year 1889-90 which should be increased by $1,000 a year until the donation should reach $25,000 a year, this to remain thenceforth an annual appropriation. After deducting one-sixteenth of this fund for the Lincoln Institute, Missouri gives one-fourth of the remainder to the School of Mines.

In 1891, the government returned to the various states the sums collected from their citizens by the imposition during the Civil War of a "direct tax." The amount thus refunded to Missouri was $646,958.33, and the 36th General Assembly of the State won the gratitude of the friends of the higher education by establishing this as a permanent endowment for the State University, specifically designating one-fifth as the portion of the income from this source which should belong to the School of Mines. The investment of the fund in 5 per cent. State certificates yields to the school annually $6,469.58.

From these three sources, then, the school enjoys an annual revenue of slightly more than $15,000. Such additional sums as are necessary for its support are furnished by biennial legislative appropriations.

Location.

The School of Mines is situated at Rolla, the county seat of Phelps County. Rolla is a town of about 2,000 inhabitants on the St. Louis and San Francisco R. R., approximately half way between St. Louis and Springfield. It has an elevation of 1,140 feet above the sea level, and enjoys an agreeable and notably healthful climate. Not infrequently families from less favored climates move hither, seeking at once the health of the

older members, the education of the younger. Its position on a great trans-continental railway system (the "Santa Fé") renders it readily accessible from all quarters. It is within easy reach of the lead and zinc district of the southwest, and of the lead and iron regions of the southeast, while opportunities to observe processes of mining and smelting the latter ores are close at hand. Visits of inspection to these mining fields are expected to be an important means of instruction.

Technical Courses.

PLAN OF INSTRUCTION.

It is the object of the instruction at this institution, first, to lay a broad and solid foundation in the way of acquaintance with principles and theory, and to supplement this, wherever possible, by the discipline of practical application in the laboratory and the field. Lectures and recitations are arranged to come in the morning hours, leaving the afternoon for laboratory and field work. This practical work is designed to illustrate and impress principles, to familiarize with the use of instruments and apparatus, to give valuable experience in operations with which the student is to be concerned in the work of his profession, and to afford an opportunity for original investigation. With additions now making, the school will be well provided with laboratories and equipment, of which it makes a large use.

Each applicant for a degree is required during his Senior year to present to the Faculty a Thesis, recording the result of some original investigation or independent research in a subject connected with his course. It must be accompanied

with any drawings that may be necessary to illustrate it, and a copy of it must be deposited with the Librarian for preservation. The acceptance of this Thesis as satisfactory is a condition of graduation.

ADMISSION.

Persons of both sexes, sixteen years of age or over, whether residents of the State or non-residents, may be admitted upon evidence of sufficient preparation. The entrance requirements—which are confessedly not high—have been fixed through considerations of the express design of the school "to promote the education of the industrial classes," and of the educational opportunities of those whose interests were chiefly contemplated in its establishment. The importance in scientific education of the fundamental branches of Mathematics and a frequently observed lack on the part of applicants of thoroughness in them has led to the inclusion of Algebra, Geometry and Elementary Physics in the work of the Freshman year. It has seemed better to teach these subjects than to let the student proceed with insufficient knowledge of them, or to exclude otherwise worthy applicants for delinquency due in many cases to lack of opportunity. At the same time, with the development of our public school system and a preceptible rise in the grade of our entering students, it is hoped that it may soon be feasible to advance the conditions of admission. At present to enter the Freshman Class a knowledge of English Grammar and Composition, Arithmetic, and Elementary Algebra as far as Quadratic equations is necessary.

Following is a list of Schools whose courses have been approved by the University, and whose diplomas will admit to the Freshman Class without examination. By an order of the Board of Curators the student who obtains the highest

rank in the graduating class of any of these schools will be admitted without the payment for the first year of the usual entrance fee.

NAME OF SCHOOL.	SUPERINTENDENT AND PRINCIPAL.
Appleton City Academy	G. A. Thielman.
Bethany High School	J. R. Hale.
Bolivar High School	W. S. Bruce.
Buchanan College, Troy, Mo.	C. H. Stumberg.
Cameron High School	B. Riggs. F. P. Finnell.
Carrollton High School	F. N. Peters. L. W. Rader.
Carthage High School	J. M. White. R. D. Ford.
Chillicothe High School	W. F. Jamison. A. J. Ellett.
Brookfield College	M. H. Reaser.
Cooper Institute, Boonville, Mo	Anthony Haynes.
Ft. Smith High School, Ft. Smith, Ark.	J. L. Holloway.
Hannibal High School	R. B. D. Simonson. Miss Gertrude Ashmore.
Harrisonville High School	A. F. Treakle.
Higginsville High School	H. B. Walker.
Independence High School	Wm. F. Bahlman. Wm. L. C. Palmer.
Jefferson City High School	J. U. White. O. K. Brown.
Joplin High School	W. B. Brown. J. D. Eliff.
Kansas City High School	J. M. Greenwood. John T. Buchanan.
Kemper Family School, Boonville, Mo	T. A. Johnston.
Lamar High School	W. H. Martin.
Lancaster High School	W. C. Thompson.
Louisiana High School	A. P. Settle. R. R. Rowley.
Marmaduke Military Institute, Sweet Springs, Mo.	Charles L. Howard. W. H. Butts.
Marshall High School	R. H. Emberson. C. A. Snodgrass.
Maryville High School	A. E. Clarendon. G. W. Fisher.

Marionville Collegiate Institute, Marionville, Mo..M. L. Curl.
Mexico High School ..... D. A. McMilton. H. S. Major.
Miami High School.....E. E. Barnett.
Michigan Military Academy, Orchard Lake, Mich.
Missouri Military Academy, Mexico, Mo.....A. F. Fleet.
Moberly High School..... J. T. Muir. J. A. Whiteford.
Monroe City High School.....R. S. Nichols.
Mound City High School..... U. W. Gallaher.
Mountain Grove Academy, Mountain Grove, Mo., W. H. Lynch.
Mt. Vernon Academy, Mt. Vernon, Mo.....J. S. Bingham.
Nevada High School..... W. J. Hawkins. D. L. Roberts.
Paris High School..... .....W. D. Christian.
Richmond High School ..... J. M. Baily. J. E. Dunn.
Rockport High Schools ....B. F. Brown.
Sedalia High School ..... G. V. Buchanan. J. D. Wilson.
Shelbina High School.....J. T. Vaughn.
Slater High School .....G. W. Newton.
Springfield High School..... J. Fairbanks. H. A. Hollister.
St. Joseph High School ..... Edward B. Neely. C. E. Miller.
St. James Military Academy, Macon City, Mo.....F W. Blees.
St. Louis High School ..... E. H. Long. F. Louis Soldan.
Trenton High School .... H. E. DuBois. E. M. Bainter.
University Academy, Columbia, Mo.....Herman F. Harris.
Wentworth Military Academy, Lexington, Mo ....Sanford Sellers.
Westport High Sbhool..... S. A. Underwood. Sarah E. Steele.

Candidates may be admitted to "advanced standing," (that is to enter the Sophomore or the Junior class) either upon examination in the subjects of the previous year or years, or upon certificate from another institution of work in the

* Where two names are given the first is that of the Superintendent and the second that of the Principal.

estimation of the Faculty fairly equivalent to that done here by the class into which entrance is sought. Applicants for advanced standing should communicate with the Director as early as possible.

Courses of Study.

The School of Mines offers three complete Technical Courses, each extending through four years, viz.:

I. Mining Engineering.
II. Civil Engineering.
III. Chemistry and Metallurgy.

Course I. is a general course in Mining Engineering, having in view all the operations in connection with mining, from the prospecting for the mine to the delivery of the finished product on the market.

Course II. is a course in Engineering as applied especially to Railways, Highways and Municipal Works.

Course III. contemplates especially processes in Mining and Metallurgy subsequent to the delivery of the ore above ground. It fits a man for a position as Chemist and Assayer or in other connection with concentrating plants and smelters.

Two options are offered in the Senior year as the candidate may wish to specialize in the direction of Metallurgy or of Analytic Chemistry.

For the completion of any of these courses the degree of Bachelor of Science is given. The further degree of Engineer of Mines, Civil Engineer or Metallurgical Engineer will either

be conferred for an additional year's post-graduate work, approved in quantity and character by the Faculty; or may be awarded to graduates who have had practical experience in the work of their profession of such duration and value as to warrant its bestowal.

Following is a table giving the distribution of the work required in the courses, with the number of exercises per week in each subject and the hours of the day at which these occur. Readers who seek information as to the content of any course should study it as outlined in the table, turning to the subsequent departmental statements for description of the instruction given in the various subjects.

FRESHMAN YEAR.

FIRST TERM.

Hours for Lectures.	Course in Mining Engineering.	No. per week...	Course in Civil Engineering.	No. per week...	Course in Chemistry and Metallurgy.	No. per week...
8:30 to 9:30	English Course III...	3	English Course III....	3	English Course III....	3
8:30 to 9:30	Elementary Physics...	2	Elementary Physics..	2	Elementary Physics..	2
9:30 to 10:30	Plane Geometry.....	4	Plane Geometry.....	4	Plane Geometry	4
9:30 to 10:30	Elementary Physics...	1	Elementary Physics..	1	Elementary Physics..	1
10:30 to 12:30	Drawing (Section I)...	2	Drawing (Sec. I).....	2	Drawing (Sec. I).....	2
10:30 to 12:30	Shop Practice (Sec. I).	2	Shop Practice (Sec. I)	2	Shop Practice (Sec. I)	2
2:00 to 3:00	Higher Algebra.....	5	Higher Algebra.....	5	Higher Algebra.....	5
3:00 to 5:00	Drawing (Section II)..	2	Drawing (Sec. II).....	2	Drawing (Sec. II).....	2
3:00 to 5:00	Shop Practice (Sec. II)	2	Shop Practice (Sec.II)	2	Shop Practice(See. II)	2

SECOND TERM.

8:30 to 9:30	English Course IV....	3	English Course IV....	3	English Course IV....	3
8:30 to 9:30	ElementaryMechanics	2	ElementaryMechanics	2	ElementaryMechanics	2
9:30 to 10:30	Solid Geometry.....	4	Solid Geometry.....	4	Solid Geometry.....	4
10:30 to 11:30	Elementary Chemistry	3	Elementary Chemistry	3	ElementaryChemistry	3
10:30 to 12:30	Drawing (Sec. I).....	2	Drawing (Sec. I).....	2	Drawing (Sec. I).....	2
10:30 to 12:30	Shop Practice (Sec. I)	2	Shop Practice (Sec. I)	2	Shop Practice (Sec. II)	2
2:00 to 3:00	Plane Trigonometry..	5	Plane Trigonometry..	5	Plane Trigonometry..	5
2:00 to 3:00	Drawing (Sec. II).....	2	Drawing (Sec. II).....	2	Drawing (Sec. II).....	2
2:00 to 3:00	Shop Practice (Sec.II)	2	Shop Practice (Sec. II)	2	Shop Practice (Sec. II)	2

SOPHOMORE YEAR.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
	FIRST TERM.					
8:30- 9:30	Descriptive Geometry..	2	Descriptive Geometry..	2	Descriptive Geometry...	2
8:30- 9:30	Surveying.....	1	Surveying.....	1	.....	..
9:30-10:30	Analytic Geometry.....	5	Analytic Geometry.....	5	Analytic Geometry.....	5
10:30-11:30	French or German.....	3	French or German.....	3	German.....	3
11:30-12:30	General Inorganic Chemistry.....	3	General Inorganic Chemistry.....	3	General Inorganic Chemistry	3
2:00- 5:00	Drawing and Field Practice.....	3	Drawing and Field Practice.....	3	Drawing.....	2
1:30- 5:30	Chemical Laboratory...	2	Chemical Laboratory...	2	Chemical Laboratory..	3
	SECOND TERM.					
8:30- 9:30	Surveying.....	2	Surveying.....	2	....	.
8:30- 9:30	Stereotomy.....	1	Stereotomy.....	1	Stereotomy.....	1
9:30-10:30	Differential Calculus...	5	Differential Calculus....	5	Differential Calculus...	5
10:30-11:30	French or German.....	3	French or German.....	3	German.....	3
11:30-12:30	Applied Chemistry.....	3	Applied Chemistry.....	3	Applied Chemistry.....	3
2:00- 5:00	Drawing and Field Practice.....	2	Drawing and Field Practice.....	3	Drawing.....	2
1:30- 5:30	Chemical Laboratory...	3	Chemical Laboratory,..	2	Chemical Laboratory...	3

JUNIOR YEAR.

FIRST TERM.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
8:30- 9:30	Integral Calculus.....	3	Integral Calculus.....	3	Integral Calculus.....	3
8:30- 9:30	*French.....	2	*French.....	2	Theoretical Chemistry..	3
9:30-10:30	Ore Dressing.....	1	Lines of Communication	2	.....	..
10:30-11-30	Physics.....	3	Physics.....	3	Physics.....	3
10:30-11:30	Mineralogy.....	2	Mineralogy.....	2	Mineralogy.....	2
11:30-12:30	Ore Dressing.....	2	.....	..	Ore Dressing.....	2
11:30-12:30	*German.....	3	*German.....	3	German.....	3
2:00- 5:00	Drawing and Field Practice.....	1	Drawing and Field Practice.....	3	.....	..
1:30- 5:30	Chemical Laboratory...	4	.....	..	Chemical Laboratory...	4
Mondays...	Practical Ore Dressing..	..	.....	..	Practical Ore Dresing...	

SECOND TERM.

8:30-9:30	Analytic Mechanics.....	3	Analytic Mechanics	3	....	
8:30-9:30	French or German.....	2	French or German.....	2	German.....	2
9:30-10:30	Materials of Enginer'g	..	Materials of Enginer'g	..	.....	
	Masonry Construction	2	Masonry Construction	2	Theoretical Chemistry..	3
9:30-10:30	Mining.	2	.....	..	.....	
10:30-11:30	Physics..	3	Physics.....	3	Physics....	3
10:30-11-30	Mineralogy.....	2	.....	..	Mineralogy.....	2
11:30-12:30	Metallurgy	3	Metallurgy	3	Metallurgy...	3
2:00-5:00	Drawing and Field Practice.....	1	Drawing and Field Practice.....	3	. ...	
2:00-5:00	Physical Laboratory. ...	2	Physical Laboratory	2	Physical Laboratory....	2
1:30-5:30	Chemical Laboratory...	2	.....	..	Chemical Laboratory...	3

*Alternative.

SENIOR YEAR.

Hours for Lectures.	Course in Mining Engineering.	No. per week.	Course in Civil Engineering.	No. per week.	Course in Chemistry and Metallurgy.	No. per week.
	FIRST TERM.					
8:30 to 9:30	Geology	3	Geology	3	Geology	3
8:30 to 9:30	Metallurgy	2			Metallurgy	2
9:30 to 10:30	Metallurgy	1	Astronomy	2	Metallurgy	1
9:30 to 10:30					Metallurgical Problems	1
10:30 to 11:30	Hydraulics and Graphic Statics.	5	Hydraulics and Graphic Statics.	5	Chemical Synthesis.	2
11:30 to 12:30	Electrical Transmission	2	Electrical Transmission	2	Electrical Trans. mission	2
11:30 to 12:30	Mining	3				
2:00 to 5:00	Physical Laboratory	1	Physical Laboratory	2	Physical Laboratory	2
2:00 to 5:00	Drawing	1		3	Designing	1
2:00 to 5:00	Metallurgical Laboratory	1	Drawing and Field Practice		Metallurgical Laboratory	1
2:00 to 5:00	Mining Designs	1				
					Chemical Laboratory.	
	SECOND TERM.					
8:30 to 9:30	Economic Geology	3	Economic Geology	3	Economic Geology	3
8:30 to 9:30					Metallurgical Problems	1
9:30 to 10:30	Metallurgy	3			Metallurgy	3
9:30 to 10:30	Electrical Transmission	2	Electrical Transmission	2	Electrical Transmission	2
10:30 to 11:30			Bridge and Sanitary Engineering	5		
11:30 to 12:30	Prime Movers and Power Transmiss'n	3				
11:30 to 12:30	Mechanics of Engineering	2	Mechanics of Engineering	2		
2:00 to 5:00	Physical Laboratory	2	Physical Laboratory	2	Physical Laboratory	2
2:00 to 5:00	Drawing	1	Drawing and Designing	3	Designing	1
2:00 to 5:00	Mining Designing	1				
Monday	Metallurgical Laboratory				Metallurgical Laboratory.	
					Chemical Laboratory and Thesis.	

The table shows the Metallurgical option in the Senior Year of Course III. Those who wish to specialize in the direction of Analytic Chemistry will in that year take Geology (3) and Metallurgy (3) throughout the year; Chemical Synthesis (2) and Physical Laboratory (2) in the first term, devoting all the remainder of their time to work in the Chemical Laboratory.

Special Courses.

For the benefit of those who may lack the time, the money or the inclination to spend four years in preparation for professional work, certain special courses, designed to confer competent knowledge of particular departments of engineering work are offered. These are :

I. ASSAYING AND TECHNICAL ANALYSIS.

This course, which is outlined on page 34, may, with diligence, be completed by mature students who have some knowledge of Chemistry in one year. An additional year, which may in some cases be necessary, may in all cases be profitably spent in more work in Analytical Chemistry and related electives.

II. SURVEYING.

The purpose of this course is to turn out competent Land and Mine Surveyors and fair draughtsmen. The essentials of it are a thorough knowledge of Algebra, Geometry, Trigonometry, Surveying, Descriptive Geometry and Stereotomy, with Field Practice and Drawing. It may be completed in

one year or in two years, according to the advancement of the applicant upon entrance. By combining with this the courses in Mineralogy, Geology, Mining and Ore-dressing industrious students, especially such as have had some practical experience, may in two years attain considerable competency for the conduct of mining operations.

III. ELECTRICITY.

A knowledge of the theory of Electricity and some acquaintance with its manifold applications in the arts is in these days of prime importance to every engineer—especially to the mining engineer, whose duties are so varied. Hence, in the regular courses this subject receives a liberal share of attention. The School does not design to offer a course in electrical engineering, but students who have completed satisfactorily the courses in Shop Work, in Chemistry through the Sophomore year, in Mathematics through the Calculus, and in General Physics, with all the under-graduate work, both theoretical and practical, in Electricity and Magnetism as outlined on page 46, will have attained a considerable proficiency in Electricity, theoretical and applied.

Applicants will be admitted to these courses only when they are of such maturity, have had such preparation, and evince such seriousness of intention as to indicate that they are likely to pursue the same with profit. Matriculates in any of the regular degree courses will not be allowed to lapse into a special course except upon presentation to the Faculty of convincing reasons for such change.

For the satisfactory completion of any of these special courses a Certificate of Proficiency in the course pursued is granted.

Engineering.

Prof. Harris.

T. G. Poats, Instructor in Shop Work and Drawing.

FRESHMAN YEAR.

SHOP WORK.—All Freshmen spend four hours a week in the shop. The School is at present prepared to give instruction only in wood-work. This is essentially Manual Training, and comprises exercises in joining, carving, turning and constructing. The use and care of tools is first taught. This is followed by a carefully graded series of exercises, at first of an elementary character, subsequently leading up to the more difficult problems in the carpentry of engineering construction.

DRAWING.—The student is familiarized with the draughting instruments by appropriate exercises in copying and in shading with the ruling pen; scaled drawing from detail plates; brush shading for plane and curved surfaces; free hand drawing from copies and models.

SOPHOMORE YEAR.

FIRST TERM.

DESCRIPTIVE GEOMETRY.—Theory of parallel and of central projections as applied to the science of drawing, with numerous exercises in determining projections of familiar

objects, intersections of plane and of curved surfaces, sections, developments and shadows. (Text—Low's Descriptive Geometry.)

Field Instruments.—The field instruments of the engineer are dissected and studied in every detail, their theory, construction and adjustments receiving careful attention. Their uses and capabilities are thoroughly discussed and applied in field practice. (Lectures.)

Drawing.—Much of the time given to drawing in this term is devoted to the exercises in descriptive geometry. Finished plats of all surveys made in field practice will be required.

Field Practice.—The student is first taught to adjust the instruments properly and to test their accuracy. Problems are then assigned in traversing and parting off land, in direct and indirect leveling, and in triangulations, all of which must be carried out in the field.

SOPHOMORE YEAR.

SECOND TERM.

Engineering Geodesy.—General and particular methods of traversing, triangulating, direct and indirect leveling; land, city, topographical, hydrographical and mine surveying; United States system of subdivisions of land. (Text—Johnson's Surveying, with lectures.)

Perspective Drawing.—(Lectures.)

Stereotomy.—The application of Descriptive Geometry to the art of stone-cutting—obtaining the projections, templets and directing instruments for the individual stones in the

various forms of structures and the construction of models of the same. (Text—Warren's Stone-Cutting, with lectures.)

DRAWING.—Some complete engineering structure must be presented in isometric, another in perspective. A neat topographical map must be made from notes taken in field practice.

FIELD PRACTICE.—The exercises in field practice are continued. Topographical Surveying will receive particular attention.

JUNIOR YEAR.

FIRST TERM.

RAILWAY ENGINEERING. (*Civil Engineering Course.*)—Surveys, construction and maintenance of railways. (Text—Searles' Field Book, with lectures.)

STREET AND HIGHWAY ENGINEERING. (*Civil Engineering Course.*)—Surveys, construction and maintenance. (Text—Byrnes' Highway Construction, with lectures.)

DRAWING.—The work assigned in drawing is adapted to the profession chosen by the student. It will consist of plats, profile and sections from notes taken in field practice, and of working drawings of simple engineering structures. Such drawings must be accompanied by estimates of material and of cost.

FIELD PRACTICE.—The student is exercised in Railway Surveying and in setting out earthwork and masonry. A map, profile and estimate of cost of a section of a railway must be produced from notes taken in field practice.

JUNIOR YEAR.

SECOND TERM.

MATERIAL OF ENGINEERING.—The principal timbers, metals, stones, clays, cements, etc., used in engineering con-

structions are studied; the investigation including sources of supply, demand, preparation and modes of preservation. (Lectures.)

MASONRY CONSTRUCTION.—Foundations, strength and stability of stone and brick masonry, concretes, cements and mortars. Specifications. (Text—Baker's Masonry Construction.)

FIELD PRACTICE AND DRAWING.—Work of first term continued. The standard method of testing cement will be carried out in detail.

SENIOR YEAR.

FIRST TERM.

HYDRAULICS.—Collection and measurement of water conveyance through pipes and canals; design of pipe lines. (Text—Merriman's Hydraulics.)

STATICS OF ENGINEERING STRUCTURES.—General study of static forces—graphically and analytically—with applications in determining conditions of stability of engineering structures and strains in simple framed structures; design of beams and posts.

FIELD PRACTICE AND DRAWING.—Senior classmen must direct and check the work of the Sophomore and Junior classes. A variety of exercises in graphic statics will be assigned.

SECOND TERM.

BRIDGE ENGINEERING.—(*Civil Engineering.*)—Loads on bridges and roofs, strains in pieces—design and dimensions of pieces; design of connections. (Text—Johnson's Structures and Dubois' Strains in Framed Structures.)

PRIME MOVERS.—(*Mining Engineering.*)—Hydraulic motors, steam engines and boilers.

TRANSMISSION OF POWER.—(*Mining Engineering.*)—By cable, compressed air and electricity.

SEWERAGE, WATER SUPPLY OF CITIES AND IRRIGATION. —(*Civil Engineering.*)

ASTRONOMY.—Determination of latitude, longitude and time, with reading and lectures in Descriptive Astronomy. —(*Civil Engineering.*)

DRAWING AND DESIGNING.—Detail working drawings of some of the structures studied will be required. The thesis must be accompanied by illustrative drawings.

LABORATORY WORK.—(*Mining Engineering.*)—Experiments with the indicator, calorimeter and dynamometer.

Chemistry.

Prof. Seamon. Mr. Thomas.

The instruction in this department is solely intended to meet the requirements of those preparing themselves for positions as Assayers, Chemists, Metallurgists and Mining Engineers. Scarcely any attention whatever is paid to the subject of Organic Chemistry. Each year instruction in the following courses is regularly given:

1. Elementary Inorganic Chemistry. II. General Inorganic Chemistry. III. Theoretical Chemistry. IV. Applied Chemistry. V. Qualitative Analysis. VI. Technical Analysis and Assaying. VII. Quantitative, Mineral, Water, Gas and Commercial Analysis.

I. Elementary Inorganic Chemistry.—In this course careful detailed instruction is given in the fundamental principles of Chemistry with a description of the most important elements and compounds and the formation and solution of chemical equations.

II. General Inorganic Chemistry.—This course differs from the first in that the instruction is more advanced and the treatment necessarily more comprehensive and exhaustive. Regular exercises are given in Stoichiometry. Richter's Inorganic Chemistry is used as a text.

III. Theoretical Chemistry.—Twenty lectures on the subject of Historical Chemistry, fifty on Physical Chemistry and twenty-five on Thermal Chemistry, constitute the advanced theoretical instruction for those specially preparing themselves for professional work in Chemistry and Metallurgy. The lectures are based on the works of Ostwald, Naumann, Nernst, Thommsen, Berthelot and Gibbs, and are intended to place the student in sympathetic touch with the latest developments of the "new" or "physical" chemistry.

IV. Applied Chemistry.—The instruction is by lectures, and covers the chemistry of cements, mortars, explosives, oils, varnishes, paints, fuels and other non-metallic materials employed in engineering operations. The processes of manufacture are also considered.

V. Qualitative Analysis.—The student is thoroughly drilled in the uses of the blowpipe and wet tests for the detection of the metals, acids and bases, commonly occurring in alloys, minerals, rocks and waters. The exercises are arranged in graded series of increasing difficulty. Each series must be completed to the satisfaction of the instructor before the student is allowed to begin the next. The time required by the average student, to complete the course in one session, is about fifteen hours per week.

VI. Technical Analysis and Assaying—The student is

first required to make complete analysis of Barium Chloride; Di-Sodic Phosphate, Strontium Nitrate, Nickel Ammonium Sulphate and Manganese Carbonate. Afterwards he is drilled in the valuation of coals and the ores of lead, zinc, iron, copper, silver, gold, tin and maganese. Complete analyses of fluxing materials, slags, mattes, steel, iron, bullion, lead and zinc are required. The methods taught are those commonly employed for quick determinations in mining and metallurgical plants. Each student makes two hundred assays of lead, silver and gold ores by fire methods. To complete the course in one session the average student usually works about twenty-four hours each week.

VII. Quantitative, Mineral, Water, Gas and Commercial Analysis. — The exercises in this course may be varied somewhat, to meet the peculiar requirements of individual students. In general, methods of analysis are investigated and applied to minerals and technical products; furnace gases and natural waters are analyzed. Special attention is paid to methods for the commercial analysis of oils, fats, paints, varnishes, cements and clays. An extensive course of chemical reading is arranged for each student. The instruction is primarily intended for students preparing themselves for positions as Analytical and Consulting Chemists. The student taking the course is expected to devote about forty hours a week, throughout an entire session, to reading and work in the Chemical Laboratory.

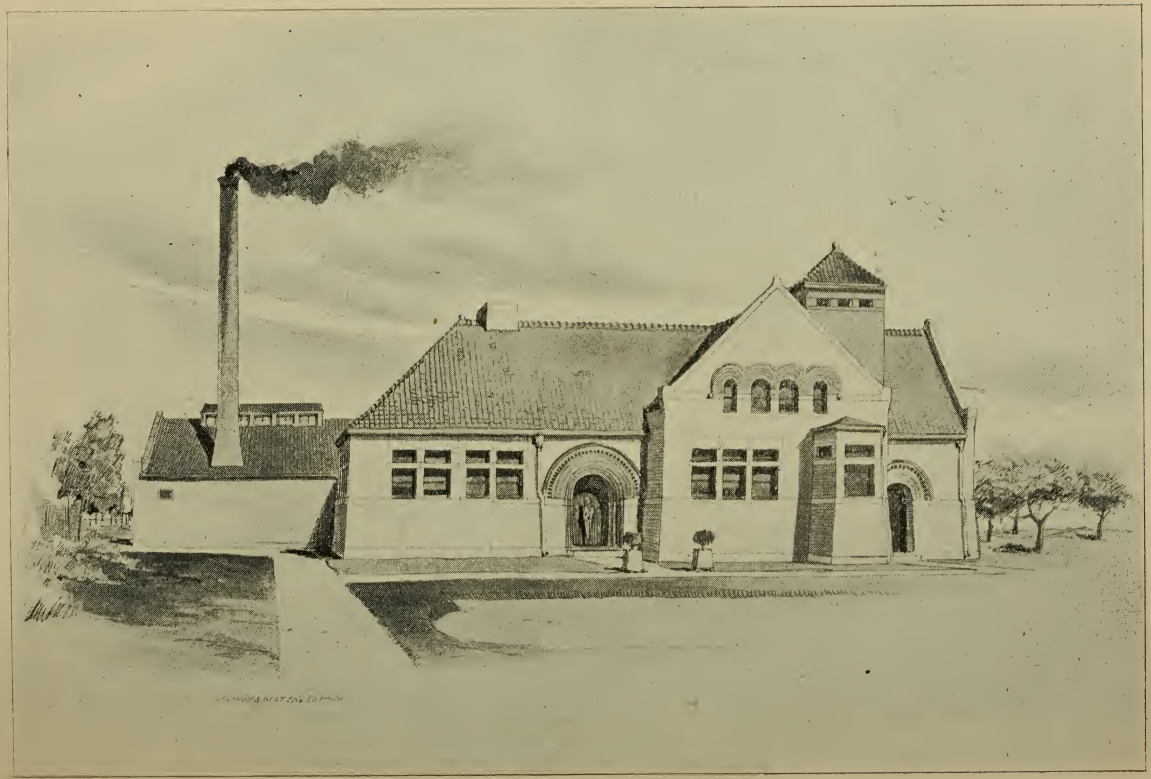
Each Laboratory class meets once each week in conferences over new methods and forms of apparatus employed in chemical work. The qualities of self-reliance and confidence are developed as far as possible in the student. Thoroughness, accuracy and reasonable rapidity are insisted upon, and each student is required to repeat the exercise until he attains a high degree of proficiency.

An Assayer's Certificate is given to students who com-

plete courses II., IV., V. and VI. Good workers can complete them in one year by devoting their entire time to the work.

No extra charge is made for the privilege of working in the Chemical Laboratory; but each student is required to pay for the materials he may consume and the apparatus he may break. Supplies and materials may be obtained from the School at cost prices. The cost of taking the several courses should not exceed the following sums: For the course of Qualitative Analysis, $15.00; in Technical Analysis and Assaying, $50.00; and in the Quantitative, Mineral and Gas Analysis, $25.00.

Text-Books and Works of Reference.—Notes of the Professor; Roscoe's Elementary Chemistry; Fresenius' Qualitative and Quantitative Analysis; Classen's Mineral Analysis; Crooke's Select Methods; Furman's Technical Analysis; Watt's Dictionary of Chemistry; Wagner's Chemical Technology; Thorpe's Dictionary of Applied Chemistry; Nernst's Theoretische Chemie; Naumann's Thermo-Chemie; Berthelot's Lecons sur la Thermochimie, Les Origines de l'Alchimie, La Chimie des Anciens et du Moyen Age; Meyer's History of Chemistry, etc.



Mining and Metallurgical Laboratory.

Mining and Metallurgy.

Prof. DeKalb.

Instruction in this department embraces the following subjects:

MINERALOGY AND GEOLOGY.

Mineralogy.
Lithology.
Dynamical Geology.
Historical Geology.
Economic Geology.
Ore Deposits.

MINING.

Lectures on Mining.
Mine Surveying.
Ore Dressing.
Mining Design.
Practical Ore Dressing.

METALLURGY.

Principles of Metallurgy.
Metallurgy of Iron, Copper, Lead, Zinc, Gold, Silver, etc.
Metallurgical Problems.
Metallurgical Design.
Practical Metallurgy (Laboratory).

The subjects taught and the methods of instruction pursued are intended as an adequate preparation for the work which graduates may be expected to perform in the actual practice of their profession as mining engineers and metallurgists.

In the brief period of a course of collegiate education it is not possible to train a student to that skill in engineering and metallurgical operations which comes only from long experience in the field, but the best procedure, in accordance with modern practice in our most successful works and mines, is taught in lecture room and laboratory, thus enabling the industrious to acquire proficiency in their chosen sphere of usefulness without loss of time. Problems, projets, memoirs, reports on assigned work, visits of inspection to mines, works, etc., with geological excursions are made a prominent feature in the courses. Actual concentration and metallurgical treatment of ores, with original experimental work in the Mining and Metallurgical Laboratory, which is admirably equipped for this class of instruction, will make the student familiar with the methods employed in large milling and reduction works, and will afford him valuable practical experience before leaving school. In this portion of the course the student is required, as far as possible, to exercise independence of judgment and to rely upon his own resources.

SYNOPSIS OF COURSES.

COURSE IN MINERALOGY AND GEOLOGY.

MINERALOGY.—A two term course, including crystallography, practical determination of minerals by their physical characters, and by their blowpipe characters, lithology

and the practical determination of rocks. The necessary elementary principles are given by lectures, but the work is principally practical determination.

LITHOLOGY.—This subject is treated as a continuation of MINERALOGY.

DYNAMICAL GEOLOGY.—LeConte's Elements of Geology is used as a text. The work is continued into the making of Geological sections and Geological field work.

HISTORICAL GEOLOGY.—The same text is used as above, supplemented by practice in the determination of fossils, with a view to practical application in the identification of geological horizons.

ECONOMIC GEOLOGY.—This is a course of lectures and recitations on the products of economic value from the different geological formations, including a thorough treatment of the characteristics and genesis of ore deposits.

COURSE IN MINING.

LECTURES ON MINING.—Lectures on Prospecting, Exploitation, Extraction, Transportation, Drainage, Ventilation, Lighting, Accidents, Hygiene and Mining Law, extend through two terms, covering the entire field. Projets involving individual investigation are assigned to the class. Memoirs and Reports to the Department are required on all investigations and visits of inspection. Special attention is given to the economical working of mines.

MINE SURVEYING.—The best methods employed are taught by lectures and recitations. Practical work, followed by the making of mine maps from the notes, is required. The instruction is included under LECTURES ON MINING.

ORE DRESSING.—Lectures, Memoirs, Location of Plant, Hand Dressing, Crushing, Comminution, Classification, Con-

centration, Preparation of Coal, Special Methods. An additional term is given to the students in Metallurgy on advanced work in the preparation of ores for smelting, the instruction being in the form of practical laboratory testing.

Mining Design.—Projets in Mining and Metallurgy. Design and working drawings of hoisting works, mine drainage plants, transportation (underground and ærial, etc.), Mine maps. All work is original and from specifications. Design of plants, furnaces, and special appliances. Geological sections from field notes. Thesis work.

Mining Laboratory.—Every Monday, for one term, is devoted to work in Ore Dressing on Practical Tests of Ores. The Laboratory is fitted with a full-sized Ore Dressing Plant, having various types of machines, thus allowing comparative tests to be made on any ore submitted. Memoirs are required on all work.

COURSE IN METALLURGY.

General Metallurgy.—A full course of lectures covering the application of chemistry to metallurgy; formation, fusibility and calculation of silicates; fluxes; furnaces; refractory materials; chimneys; heat of combination; fuels, natural, and artificial; combustion; fire-places; gas producers, utilization of products, etc., is given in the second term, Junior year. Practical problems are assigned to the class for solution throughout the course. These problems are an important feature in that they require the men to apply all the information they may have acquired and give them facility in the use of data.

"An Introduction to the Study of Metallurgy," by W. C. Roberts-Austen, is used as a text.

Metallurgy of Iron, Copper, Lead, Zinc, Gold, Silver, Aluminum, etc.—Text-books are used where available; the

remainder of the instruction is by lectures and references. Special attention is paid to Missouri ores and products. Peters, Hofman, Eissler, etc., are the authors used as texts.

METALLURGICAL PROBLEMS.—Under this head, special attention is given to subjects not taught in the regular lecture courses. They involve problems in advanced Metallurgy, heat distribution, calculation of charges, distribution of power, criticism of designs, designs from specifications, testing for process, etc. It is preliminary to Metallurgical Design. The aim of the instruction is to familiarize students with the special problems occurring in practical metallurgy. It also includes original investigations in metallurgical chemistry.

METALLURGICAL DESIGN.—The design and laying out of works, design of furnaces with appropriate accessory machinery, etc., is taught in the draughting room. The practice here, as elsewhere, is in accordance with the most approved methods as employed in the best designing-rooms in this country. All work is original and done from specifications. Thesis work.

METALLURGICAL LABORATORY.—This work is intended not only to illustrate practically some of the principal metallurgical processes, but also to make comparative tests of processes in order to determine their adaptability to special classes of ores.

Determination of temperature, calorific power of fuels, fusibility of refractory materials, making of alloys, examination of materials sent to the school, in short, practice in such operations as a metallurgical engineer must at some time have occasion to perform. The Laboratory is admirably fitted for this class of work. Memoirs are required on all original investigations.

Mathematics.

Prof. Richards. Mr. Poats.

The exceeding importance of Mathematics as the basis of a scientific education justifies the emphasis laid upon it in the school. At the same time that the facts are taught, the utility of mathematical study as a mental discipline is duly recognized, and an effort is made to promote habits of exact logical reasoning, and to stimulate originality and independence of thought.

In the various courses the ultimate intention of the student is kept prominently in mind, and such points as have an especial bearing upon his technical work are emphasized as occasion may suggest. The tendency, however, too frequently observable in technical schools to cramp the mathematical instruction within the limits of a meagre preparation for professional work, is avoided, and the treatment of each subject is in general, designed to be as broad and full as may be in the allotted time.

At each meeting the class is examined on matter previously assigned, and, when expedient, explanations of the text and supplementary lectures and notes are given. The student is constantly exercised in work at the blackboard, reproducing demonstrations and applying demonstrated principles to the solution of special problems.

FRESHMAN CLASS.

GEOMETRY.—The class meets four times a week throughout the year, and completes the usual course in Elementary

Geometry, Plane and Solid, with numerous original exercises.

Text-Book.—Wells' Plane and Solid Geometry.

HIGHER ALGEBRA.—At the outset the class will review Radicals and Quadratic Equations. Thereafter the course will include Theory of Exponents, Surds, Imaginaries, the Progressions, Permutations and Combinations, Binomial Theorem, Series of Logarithms, Theory of Numbers, Determinants, with an introduction to the Theory of Equations. (Five times a week for five months.)

Text-Book.—Wells' University Algebra, with notes.

PLANE TRIGONOMETRY.—The class is thoroughly drilled in the Fundamental Definitions and Formulæ, and exercised in the manipulation of trigonometric equations. The construction and use of Logarithmic tables are taught, and numerous examples in the solution of triangles, involving the use of Logarithms, are given. Occasionally actual heights and distances are required to be calculated by trigonometric methods. (Five times a week for four months).

Text-Book.—Wells' Trigonometry.

SOPHOMORE YEAR.

FIRST TERM.

SPHERICAL TRIGONOMETRY.—A brief course, with some illustrations of its applications in Geodesy and Astronomy.

Text-Book.—Wells.

ANALYTIC GEOMETRY (PLANE).—The remainder of the first term is spent in the study of the Conic Section and some of the most important and interesting curves of higher degree.

Text-Book.—Wentworth's Analytic Geometry.

For Reference.—Puckle's Conic Sections, Salmon's Conic Sections and Higher Plane Curves.

SECOND TERM.

ANALYTIC GEOMETRY.—(Solid.)—The instruction includes an elementary discussion of the Line, the Plane, and surfaces of the second degree. Wentworth's Analytic Geometry is continued as a text-book, but the treatment on the subject there given is supplemented by notes. (Five times a week for four weeks.)

DIFFERENTIAL CALCULUS.—During the remainder of the term, the class meets five times a week, and studies the Differential Calculus.

The student is guarded against the error of supposing that the Calculus means any certain body of knowledge, small or large, and is taught to view it in its true light as a method of analysis, the applications of which are infinite. The logical foundation of the subject is firmly laid in the Doctrine of Limits, and the class is introduced to the applications—both geometrical and mechanical—of its principles, which are most important, both on account of the intrinsic utility of their results, and, as well, as illustrating the efficiency of the instrument which the student is learning to use.

Text-Book.—Osborne's Calculus, with lectures.

For Reference.—Williamson, Todhunter.

JUNIOR YEAR.

FIRST TERM.

DIFFERENTIAL AND INTEGRAL CALCULUS AND APPLICATIONS.—The course of the last term is continued. Among the subjects to which the Calculus is applied are the investigation of maxima and minima values of functions, the analytical study of curves, and the finding of lengths, areas and volumes by definite integration.

Text-Books.—Osborne's Calculus, with lectures.

For-References.—Williamson, Todhunter, etc.

SECOND TERM.

ANALYTIC MECHANICS.—The fruit of the training in Pure Mathematics is here tasted. The principles of Statics are developed and applied to various problems. Among the topics treated are Center of Mass, Friction, the Machines, Funicular Polygon, Catenary and Spherical Attraction, etc. In Kinetics, the fundamental equations of Motion, Projectiles, Work and Energy, Moment of Inertia are especially considered. (Three times a week.)

Text-Book.—Bowser's Analytic Mechanics.

GRADUATE STUDENTS.

Graduate students who elect work in this department will be permitted to exercise considerable latitude of choice, within the approval of the Professor. They may make a wider study of the Conic Sections by both Algebraic and Projective methods (Salmon, Cremona), Advanced Calculus (Williamson), Theory of Equations (Burnside and Panton), Determinants (Muir or Weld). Or, if they desire to pursue subjects more directly related to the physical sciences, they may take Dynamics (Williamson), Quaternions (Kelland and Tait), Differential Equations (Forsyth).

In all the classes, as each subject is taken up its origin and development are studied too, and at certain periods, more formal lectures on the History of Mathematics are given.

A collection of the chief works on Mathematics, in English, French and German, which is contained in the Library, affords the student an opportunity of extending his research at will.

Physics.

PROF. TIMMERMAN.

COURSE I. ELEMENTARY PHYSICS.—Lectures and recitations three times a week during the first term. Required of all Freshmen in the technical courses.

Text-Book.—Elements of Physics by Carhart and Chute.

COURSE II. ELEMENTARY MECHANICS.—Twice a week during the second term. Required of Freshmen in the technical courses.

Text-Book.—Elementary Mechanics by Magnus.

COURSE III. ELECTRICITY AND MAGNETISM.—Lectures and Recitations three hours per week during the first term. Required of first year students in Special Electricity. Open to those who have completed Courses I. and II. in Physics and all the required Freshman Mathematics.

Text-Book.—Elementary Lessons in Electricity and Magnetism by S. P. Thompson.

COURSE IV. PRACTICAL ELECTRICITY. — Lectures and recitations three hours a week during the second term. Required of first year students in Special Electricity. Open to those who have completed courses I., II. and III.

COURSE V. ELECTRICITY AND MAGNETISM.—Laboratory work. Two afternoons per week throughout the year. Required of first year students in Special Electricity.

COURSE VI. GENERAL PHYSICS.—Lectures and recitations three hours a week throughout the year. Mechanics, Sound and Heat during the first term; Light, Electricity and Magnetism, during the second term. Required of Juniors in the

technical courses and of second year men in Special Electricity. Open to those who have completed courses I. and II. and the prescribed courses in Mathematics, through the Sophomore year. Text-Book, Barker's Physics.

COURSE VII. LABORATORY WORK IN MECHANICS, HEAT AND SOUND.—Two afternoons a week required of Juniors during the second term; and three afternoons a week during the first term required of second year Special Electricity students.

COURSE VIII. LABORATORY WORK IN LIGHT, ELECTRICITY AND MAGNETISM.—Required of Seniors in the C. E. course, two afternoons a week during the first term, and of Seniors in E. M. and C. and M. courses one afternoon a week during the first term.

COURSE IX. ELECTRICAL TRANSMISSION OF ENERGY.—Lectures and Recitations twice a week throughout the year. Required of all Senior technical students and of second year students in Special Electricity. Open to students who have completed courses I., II., and VI., or I., II., III. and IV., and the prescribed Mathematics through the Sophomore year.

COURSE X. DYNAMO LABORATORY.—Testing of Dynamos, Motors and Transformers, Calibration of Instruments, Characteristic Curves of Dynamos and Motors, etc. Also Engine and Boiler Testing. Required of Seniors and of second year students in Special Electricity, two afternoons a week during the second term.

GRADUATE COURSE.

COURSE XI. THEORY OF ELECTRICITY AND MAGNETISM.—A Mathematical Treatment of Electricity and Magnetism. Two hours a week throughout the year. Open to graduate students and advanced undergraduates.

COURSE XII. THEORY OF ALTERNATING CURRENTS.—An analytical and geometrical treatment of the subject. Two

hours a week throughout the year. Open to graduate students and advanced undergraduates.

COURSE XIII. DESIGN OF ELECTRICAL APPARATUS.—Including dynamos, motors, alternators, transformers, etc. Open to students who have completed course IX.

Courses XI. and XII. will be given in alternate years. Course XI. in 1895-96 and Course XII. in 1896-97.

Laboratory Text-Books.—Stewart and Gee, Electricity and Magnetism; Laboratory Manual, vol. 1 and vol. 2, by E. L. Nichols; Physical Measurements by Kohlrausch.

Modern Languages.

The great quantity and worth of the technical literature in the French and German languages, added to their value as elements of liberal culture, makes at least a reading knowledge of them a highly desirable part of an Engineer's education. German is required in Course III, while the choice of French or German is permitted in Courses I. and II.

The instruction in each language is designed to present the grammatical structure and the pronunciation of the tongue, to give some acquaintance with the masterpieces of its literature, and to confer such facility in translation as will enable the student to read with ease the language in both its literary and its scientific uses.

GERMAN.

Mr. Wilkins.

First Year.—Introductory lessons on pronunciation and German script, Collar's Shorter Eysenbach, Joynes' Reader, Andersen's Maerchen. Five times per week during the first term and thrice per week thereafter.

Second Year.—Grammar and Composition, Schiller's "William Tell," Lessing's "Nathan der Weise," Goethe's "Reinecke Fuchs," and selections from other German authors.

During the second term of this year the students in Scientific German read Hodges' Course in Scientific German. They will also be required to do parallel reading in the current scientific magazines and standard scientific works.

FRENCH.

Prof. Richards.

First Year.—Otto's Grammar, Whitney's Reader, "Choix de Contes" (Daudet).

Second Year.—Grammar (continued), original exercises, Racine's "Phedre," "Le Roman d'un Jeune Homme Pauvre" (Feuillet), "L'Abbe Constantin" (Halevy), Herdler's Scientific French Reader, Marie's "Histoire des Sciences."

Parallel reading, outside of that done in class, will be assigned and will constitute part of the work on which the student is examined.

SPANISH.

Prof. DeKalb.

The growing demand for mining engineers and metallurgists in South and Central America, and in Mexico, where a knowledge of Spanish is almost an essential qualification, has

been met by the establishment of a course in this language in the School of Mines. The natural, or conversational method is followed exclusively, with Ramsey's "Modern Spanish" as a reference grammar.

The object is to give the student not a knowledge of literary Spanish, but facility in the everyday speech of the people. The instruction includes a brief course in arithmetic, keeping of accounts, geometry, surveying and chemistry, given entirely in Spanish.

Academic Course.

The Academic Course is maintained in compliance with an Act of the Legislature of 1885. It is intended to include that fundamental general culture which should in part precede and in part accompany specifically technical training—to present a liberal discipline valuable in any career. To those contemplating a professional course, here or elsewhere, who have not laid this foundation; to teachers who desire better equipment for their work, and to any others whose wants it may suffice, this course is offered. As will be seen, studies are offered in English, History, Political Economy, Logic, Mathematics, German, French, and the Natural Sciences.

To enter upon this course a knowledge of Arithmetic and English Grammar is required.

For its completion a Diploma of Graduation is conferred.

ACADEMIC COURSE OF STUDY.

FIRST YEAR.

FIRST TERM.				SECOND TERM.			
Hours of Recitation.		Studies.	Times per week.	Hours of Recitation.		Studies.	Times per week.
8:30 to	9:30	Physical Geography.....	3	8:30 to	9:30	Physiology and Hygiene.	3
8:30 to	9:30	English—*Course I*.....	2	8:30 to	9:30	General History.....	2
10:30 to	11:30	English—*Course I*.....	3	10:30 to	11:30	English—*Course II*.	5
11:30 to	12:30	General History.....	5	11:30 to	12:30	General History.....	3
2:00 to	3:00	Elementary Algebra.....	5	2:00 to	3:00	Elementary Algebra.....	5

SECOND YEAR.

8:30 to	9:30	English—*Course III*.....	3	8:30 to	9:30	English—*Course IV*.....	3
8:30 to	9:30	Elementary Physics,.....	2	9:30 to	10:30	Geometry (Solid).....	4
9:30 to	10:30	Elementary Physics.....	1				
9:30 to	10:30	Geometry (Plane).....	4	10:30 to	11:30	German or French..... ..	3
10:30 to	11:30	German or French.....	3	2:00 to	3:00	Civil Government.....	5

THIRD YEAR.

8:30 to	9:30	*French (2d year)..	2	8:30 to	9:30	French (2d year).....	2
9:30 to	10:30	English History.....	5	9:30 to	10:30	Political Economy..... ..	5
10:30 to	11:30	Elements of Psychology...	2	10:30 to	11:30	Elementary Chemistry...	3
11:30 to	12:30	*German (2d year).....	3	11:30 to	12:30	Logic	2
2:00 to	3:00	Higher Algebra.....	5	2:00 to	3:00	Plane Trigonometry.....	5
3:00 to	4:00	Zoology.....	5	3:00 to	4:00	*German (2d year).....	3
				3:00 to	4:00	Book-keeping (optional)...	2

*Alternative.

ENGLISH.—In English four courses are offered, as follows:

Courses I. and II.—The principles of written discourse; Letter-writing, and Essay. Written exercises are required daily from the belief that painstaking practice under proper supervision is the best, if not the only, means of acquiring facility in the use of good English.

Classes in these courses meet five times a week throughout the year.

Text-Book.—Butler's School English.

Courses III. and IV.—The History of English Literature from its beginning to the present. It is thought that a thorough knowledge of a few of our great writers is better than a slight knowledge of many. Students are, therefore, required to make a special study of the life, character, and masterpieces of Chaucer, Shakspeare, and such other representative authors as the time will admit. Every effort will be made to have the student acquire the ready use of good English, and to that end biographies, essays, reviews, criticisms, etc., will be required weekly. The Library is supplied with all the books of reference necessary to make these courses both interesting and instructive. Classes meet three times a week throughout the year.

Text-Book.—Nicoll's Landmarks of English Literature. Other books will be required as the classes progress.

MATHEMATICS.—A thorough knowledge of Elementary Algebra and Geometry is an essential requisite of a general education, as well as for entrance into higher scientific courses. During the first year students take Elementary Algebra, beginning with the fundamental operations and completing Quadratic Equations and the progressions. In the second year they have a thorough course in Elementary Geometry, Plane and Solid, with much practice in problem-solving. In the third year they have a course in Higher

Algebra, including the study of Series, Indeterminate Coefficients, Logarithms, Theory of Equations, Determinants, etc., and complete Plane Trigonometry.

Text-Books.—Algebra. First year — Wells' Academic Algebra. Second year—Wells' University Algebra, Wells' Plane and Solid Geometry, Wells' Trigonometry.

General History.—It is desirable that the student have as thorough knowledge as possible of Ancient, Mediæval and Modern History. For this reason, the course here offered extends throughout the entire year. Special attention will be given to the growth and development of France, Germany and other modern nations of Europe. Students will be required to make constant use of the books of reference on History, found in the library.

Text-Book.—Meyer's General History.

English History.—An effort will be made to present clearly and concisely the main facts in the History of England from the Roman Conquest to the present time. The growth of the political liberties of the people, the changes in social condition, and the advance in literature and arts will be shown as clearly as possible.

Text-Book.—Montgomery's "Leading Facts of English History."

French or German.—Students completing the Academic course are required to take two years of German or French. For information concerning the courses offered in these subjects see Modern Languages on pages 48 and 49 of this catalogue.

Physics.—In the course, the object constantly held in view is to present simply and plainly the fundamental truths of Natural Philosophy. The subjects of properties of matter, sound, light, heat and electricity are introduced upon a scientific basis and are illustrated throughout the course by experi-

ments. The department is supplied with apparatus of all kinds necessary for this purpose.

Text-Book.—Elements of Physics by Carhart and Chute.

ELEMENTARY INORGANIC CHEMISTRY.—In this course careful detailed instruction is given in the fundamental principles of Chemistry, with a description of the most important elements and compounds, and the formation and solution of chemical equations.

PHYSIOLOGY.—It is aimed to make the instruction in this branch as thorough and practical as possible, and to lead the student to obey the injunction "Know Thyself."

Text-Book.—Martin's Human Body.

PHYSICAL GEOGRAPHY.—The comprehensive nature of this study does not admit of its being treated in all its phases in the short time allotted to it.

The course will be principally descriptive, though the presentation of the scientific principles involved will be as thorough and complete as practicable, the design being to make this study serve as an introduction to the other natural sciences taken up later in the course.

Text-Book.—Appleton's Physical Geography.

CIVIL GOVERNMENT.—The text-book now in use (Young's Class Book) gives an analysis of the Constitution of the United States, presents a comparative view of the different State Governments, treats of County and Township organizations, and affords an acquaintance with such principles of law as are involved in ordinary business transactions. Special attention will be given to the Government of the State of Missouri.

POLITICAL ECONOMY.—All that is attempted in this subject, is to present in plain and simple form the elementary principles of Political Economy. The main topics are treated, the fundamental principles studied and discussed, but no attempt is made to inculcate any particular economic doctrine.

Text-Book.—Laughlin's Elements of Political Economy.

PSYCHOLOGY.—The aim in this study is to place before the student, in as simple and compact form as possible, a few of the leading facts connected with the human mind—its powers, its capabilities, its growth, and some of the ways by which these powers may be strengthened and cultivated.

Text-Book.—Hewett's Elements of Psychology.

LOGIC.—This study is intended to supplement that of Psychology. In the latter we have the analysis of the intellectual powers, in the former an investigation of the laws of correct reasoning.

Text-Book.—Hill's Jevon's Logic.

BOOK-KEEPING.—This study is not required, but will be taught upon the application of at least five students for instruction therein. The course comprises principally Double Entry. Various kinds of business are represented, and all the modern conveniences and auxiliaries are explained and used. The student is required to finish at least six different sets of books. Those who complete these before the end of the term will be furnished with abundant material for further practice.

Grounds, Buildings and Equipment.

The grounds of the School of Mines are situated in the highest part of the town of Rolla, and are somewhat over twenty acres in extent. The recent purchase of the lot intervening between the Campus proper and the "Park" has united the holdings of the school into a single continuous tract. The buildings, which are all substantial brick structures, are: the Main Building, Chemical Laboratory, Mess Club House, and the Mining and Metallurgical Laboratory, which was

recently completed and equipped, and is now occupied by the Department of Mining and Metallurgy.

The last Assembly made an appropriation of $3,500, with which it is expected that the Campus will be much improved and beautified.

Engineering Equipment.

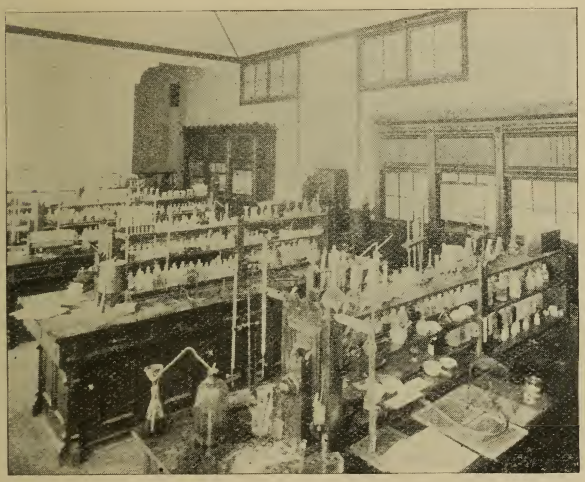
The equipment for Field Practice includes a Heller and Brightly transit with solar attachments; a Gurley Construction transit; a Plane table with stadia attachments; a Gurley Y Level; a Buff and Berger Y Level; a Gurley Solar Compass; a Gurley Vernier Compass; two Sextants; a Lock Level, with the necessary Level Rods, Chains, etc.

Tests of cement are made with a Riehle Bros.' U. S.

Standard Cement Testing machine. A Steam Calorimeter, a Thompson's Steam Engine Indicator, and a Dynamometer are used in the instruction in Steam Engineering.

The shop contains a Steam Engine, Metal Lathe, Wood Lathe, Benches for wood-work, and individual sets of hand tools.

Chemical Laboratory.



The Chemical Laboratory has been in use nine years, and has been found satisfactory. It was planned and built solely with reference to the work in the school, and the entire building is used by the Chemical Department.

In this building there are the following departments: The quantitative laboratory, the qualitative laboratory, professor's

laboratory, lecture room, assay laboratory and weighing room, a quantitative and qualitative evaporating room, preparation room, supply room and two basement rooms, furnishing accommodations for thirty-six students at a time.

In the construction of this Laboratory especial care was exercised in the design of the Assay Laboratory. It is located on the first floor, and not in the basement. The reduction furnace, as well as the muffle furnaces, are of the newest and best. Two large muffle furnaces, two smaller ones, one gas furnace, an ore crusher, pulverizing plate, ore and assay balances, with other facilities, are provided for the use of students.

Facilities for securing heat, light and ventilation are excellent; ample provision is also made for carrying off foul and dangerous gases. All parts of the building are well equipped. Gas and water are supplied to each table.

The Laboratory contains, in addition to a large assortment of the apparatus regularly and ordinarily met with in well equipped institutions, three of Becker's Analytical Balances, Contact and Reflecting Goniometers, and other valuable pieces of apparatus for work and research. Four new balances and other apparatus have recently been added.

During the past year the Laboratory has for the first time proved inadequate to the demand upon it. An appropriation of $2,500 made by the last Assembly will be applied to rearranging the Quantitative Room, so as to accommodate larger classes and to remodeling the Assay Laboratory and installing some new furnaces.

The Laboratory is open to students for work from 8 A. M. to 5:30 P. M., daily.

Physical Laboratory.

The Physical Laboratory occupies three rooms in the main building and is well supplied with standard apparatus. Additions are constantly being made to its equipment.

The Dynamo Laboratory occupies a large room in the basement of the same building. It contains among other apparatus, a 60 light direct current dynamo, a Westinghouse Alternator and Transformer, a five H. P. motor and standard measuring instrument both for direct and alternate current measurement. An engine and boiler are included in the equipment; also the necessary apparatus, such as indicators, calorimeters, etc., for complete engine and boiler tests. The work is so arranged that students become thoroughly familiar with the handling of apparatus such as is used in practical work.

A workshop, equipped with the necessary appliances for wood and metal working, is connected with the laboratory and gives students an opportunity to make whatever apparatus they may need in the pursuit of any original investigation.

Equipment in Mineralogy and Geology.

This includes a representative collection of 800 specimens of minerals for class use; 200 specimens of rocks; 150 specimens of typical fossils; a large collection illustrating metallurgical processes; a collection of 500 specimens of ore from the World's Fair. To this, additions are being made from

time to time. This material will be greatly augmented by the acquisition in 1895 of the entire Missouri Mineral Exhibit at the late World's Fair, which, by act of the State Legislature, is in the autumn of 1895, to become part of the permanent equipment of the School of Mines. A full set of instruments for Geological surveys constitutes a portion of the outfit.

Mining and Metallurgical Laboratory.

The special building for the Department of Mining and Metallurgy has been finished, and equipped with the necessary appliances for a practical course in ore concentration and reduction.

The building consists of two distinct portions, one containing a chemical and a blow pipe laboratory, lecture room reference library, draughting room, petrographical laboratory, blue print room, etc.; the other comprising a large mill room, an engine room, and a boiler room. The mill room is equipped with first class modern machinery, of standard sizes, for crushing and concentration of ores, the plant containing a Dodge rock breaker, Cornish rolls, stamp battery with automatic feeder, Calumet hydraulic classifier. Hartz jig, Spitzkasten, Frue Vanner, grinding and amalgamating pan and settler, with settling boxes. In addition to these, working models of different types of concentrators have been made by students of the School of Mines and contributed to its outfit. The reduction plant consists of a reverberatory roasting furnace, and 20 inch water jacket cupola furnace, with Root blower, for lead and copper ores. There are also assay and cupellation furnaces, and before the beginning of next term a zinc distillation furnace, lixiviation, and gold chlorination

plant, and other appliances will have been erected. The power for the above plant is derived from a 50 H. P. automatic engine; taking steam from two 35 H. P. tubular boilers.

By means of this excellent equipment students will receive practical instruction in the crushing and concentration of various ores, and in the metallurgical treatment of ores of lead, zinc, copper, gold, and silver.

There is much space remaining in the mill room which will be filled with additional appliances as rapidly as funds permit.

Library.

The Library contains 3,000 volumes. Good collections of works upon Engineering, Mathematics, Chemistry, Physics, Mining and Metallurgy afford to students in these departments an opportunity to pursue an extended course of

reading in connection with their class work. The Library also contains the standard works in English and American Poetry, Fiction, Biography and History. It is well provided with encyclopædias and works for general reference. The Library is open and in charge of the Librarian from 8:30 A. M. to 12:30 P. M. and from 2 to 4 P. M. During these hours books may be taken out and the Library room used for reading and study. The following periodicals for the current year are found on the reading tables of the Library.

American Geologist,
American Mathematical Journal,
Annales de Chemie et de Physique,
Annals of Mathematics,
Century,
Chemical News,
Colliery Engineer,
Cosmopolitan,
Electrical Engineer,
Electrical World,
Electrician,
Engineering Magazine,
Engineering News,
Engineering and Mining Journal,
Forum,
Harper's Monthly,
Harper's Weekly,
Illustrated London News,
Journal of American Chemical Society,
Journal of Franklin Institute,
Journal of Iron and Steel Institute.
Ladies' Home Journal,
Life,
Literary Digest,
McClure's Magazine,
Mining and Scientific Press,
Nation,
North American Review,
Physical Education,
Popular Science Monthly,
Review of Reviews,
Scribner's Magazine,
Technology Quarterly,
Transactions American Society of Civil Engineers,
Zeitschrift für Analytische Chemie.

Mess Club House.

The "Club House," a three-story brick building of pleasing architecture, which has been in use only four years, has recently been thoroughly repaired, cleaned, papered, and put into the best of order. It is in charge of a caterer, elected by

the Executive Committee of the School of Mines. No charge is made for room rent, but in order to engage quarters each applicant must deposit with the Treasurer of the School of Mines five dollars ($5.00), which shall be held as a contingent fund to pay for any damages for which the depositor may be responsible—the unconsumed portion of such fund being returned to him at the end of the session. Choice of rooms will be permitted in the order in which such deposits are received.

Under the present arrangement the cost of board (including fuel, lights, etc.,) is $13 a month.

Students furnish blankets, sheets, pillow cases, towels and napkins.

As the accommodations are limited, early application is advised.

General Information.

EXPENSES.

The School of Mines is endowed and supported by the State for the benefit of its sons, and seeks to offer to them its instruction at the lowest possible cost. It is believed that nowhere else in this country can equal advantages be had at such slight expense. The only fixed general charges are an entrance fee of $10.00 payable whenever the student may enter, and a library fee of $2.00 a term, payable at the beginning of each term. *There is no charge for tuition.* Students in the laboratories pay for apparatus damaged or destroyed; those in the chemical laboratory pay also for gas and fuel consumed and for chemicals used. To make this last item as small as possible the School buys such supplies at wholesale rates and

issues them to students as they are needed at corresponding prices. To cover bills arising from these sources students in Qualitative Analysis deposit upon entrance $10.00; those in Quantitative Analysis $15.00. These deposits must be renewed if at any time exhausted; at the end of the session whatever sum may remain to the credit of the depositor is returned to him.

No distinction in admission nor in charges is made between residents of this state and of other states.

Board, including lodging, meals, fuel and lights, may be had in the Mess Club for $13.00 a month; in private families for from $13.00 to $15.00; at the hotels for from $15.00 to $20.00. Washing costs from $1 to $1.50 per month.

Subjoined is an estimate of the necessary expenses for the school year:

	Moderate.	Ample.
Entrance and Library Fees	$ 14.00	$ 14.00
Books, Stationery, Chemicals	15.00	50.00
Board, fuel, lights, washing	117.00	144.00
Total	$146 00	$208.00

EXEMPTION FROM FEES.

It is ordered by the Board that "all regular graduates of any department of the University, and every regular graduate of the Normal Schools established by law within the State, and the graduates of all other regularly chartered Literary and Scientific Colleges in this State, with regular classes established therein, that are authorized by law to confer degrees and to grant diplomas to their students, shall be entitled to take *graduate* work in all the departments of the State University, including the School of Mines at Rolla, as Post-graduates, free of the payment of entrance fees."

By a similar resolution, teachers in Public Schools of Missouri will, *during the second term*, be admitted without the payment of any entrance fee. This privilege is granted to enable teachers, after their schools are closed, to utilize their time in self-improvement. The school looks for its reward to the eventual improvement of its entering students.

TERMS AND VACATIONS.

The college year is divided into two terms of nineteen weeks each. The first term begins on the third Tuesday in September, and ends about February 1. A ten-days' vacation is given during the holidays to include Christmas and New Year. There is no interval between the ending of the first term and the beginning of the second. The second term ends on Commencement Day, which is the second Thursday in June. The summer vacation extends from Commencement to the third Tuesday in September.

EXAMINATIONS.

In most of the classes there are daily oral examinations. Occasional written examinations on portions of subjects are held. These are designed to give the students a review, to practice him in the writing of examination papers, and to enlighten the professor as to the progress of his class. From these sources the monthly grades are determined. At the end of each term searching written examinations on all the matter studied during the term are held. The marks gotten in these combined with the average monthly grades determine the "term grades." To pass, 75 per cent. is required.

MONTHLY REPORTS.

Regular monthly reports are sent to the parents or guardian of each student, showing the student's grade in scholarship for the month and giving such other information in regard to his progress, attendance, etc., as may be thought of interest. The attention of parents and guardians is particularly called to these reports.

DISCIPLINE.

The School of Mines has but two general rules: 1. Be a gentleman (or a lady). 2. Work. Students who violate either of these are requested to leave. Flagrant violations of them are punished by suspension or expulsion according to the nature of the offense.

STUDENTS' SOCIETIES.

There are two scientific societies, designed to stimulate research and investigation on the part of their members—the "Mining Club," which has as its object the discussion of questions relating to mining, metallurgy and chemistry, and the "Engineers' Club," which takes for its field the consideration of topics in the various branches of engineering. Each meets fortnightly, and listens to papers by its members and occasional lectures by invited speakers. The young ladies of the school conduct the "Alpha" Club, which meets weekly for literary cultivation and entertainment.

ATHLETICS.

Through the liberality of the Curators, an athletic field has been enclosed and graded for the benefit of the students. It furnishes ample space for base-ball, foot-ball and lawn tennis. An Athletic Association exists among the students, and foot-ball and base-ball teams and a tennis club are in organization.

DEGREES.

UNTITLED DEGREES.

1. A Certificate of Proficiency is conferred on one who has attained the required standard in any of the following special courses: Assaying and Technical Analysis, Surveying, Electricity, Geology and Mineralogy, Inorganic Chemistry and Mathematics (through the Calculus).

2. A Diploma of Graduation is conferred on one who has attained the required standard in any of the following departments: Mathematics, Physics, Analytical Chemistry, Engineering, Mining and Metallurgy and the Academic Course.

DEGREES WITH TITLES.

1. The degree of Bachelor of Science in Mining Engineering, Bachelor of Science in Civil Engineering or Bachelor of Science in Chemistry and Metallurgy, will be conferred on one who has attained the required standard on all the subjects of instruction in Course I., Course II., or Course III.

2. The further degree of Engineer of Mines, Civil Engineer, or Metallurgical Engineer, will be conferred on one who, having previously graduated in Course I., Course II., or Course III., has completed satisfactorily a year's post-graduate work in residence here, or who has had professional experience in a responsible position for not less than two years.

COMMENCEMENT.

The annual Commencement exercises are held in the Assembly Room on the morning of the final day of the session, the second Thursday in June. The exercises consist of the conferring of certificates, diplomas and degrees, the reading, when advisable, by the graduates, of abstracts of their theses, and an address by some prominent speaker. At the last Commencement the address was delivered by Prof. Wm. M. Bryant, LL.D., of St. Louis. The annual address on June 13, 1895, will be delivered by Hon. C. P. Walbridge, Mayor of St. Louis.

There were awarded the following

CERTIFICATES OF PROFICIENCY.

GENERAL CHEMISTRY.

Bertrand, L.
Buskett, E. W.
Clark, C. F.
Fleck, W. I.
Fox, H. H.
Offen, A.
Eardley, A. E.
Suppan L. R. A.
Weissgerber, O.
Zelch, J. A.

MATHEMATICS.

Dyer, T.
Grove, C. D.
Gormly, S. J.
Herdman, G. W.

MINEROLOGY AND GEOLOGY.

Alexander, G. E.
Buskett, E. W.
Clark, C. F.
Dwyer, E. P.
Florreich, P.
Fox, H. H.
Gormly. S. J.
Kirkham, J. E.
McMullin, R. W.
Offen, A.
Spencer, H. G.
Thomas, W. S.

SURVEYING.

Florreich, P.
Harris, W. B.
Weissgerber, O.
Greenzweight, A. H.
Kidd, G. C.

ASSAYING.

Bertrand, L. A.

ELECTRICITY.

Ijima, Z.

DIPLOMA OF GRADUATION—ACADEMIC COURSE.

MORRIS, L. J.

DEGREES.

Bachelor of Science (in Chemistry and Metallurgy).
DELAY, T. S. THOMAS, W. S.

Bachelor of Science (in Mining Engineering),
GROVE, C. D.

Bachelor of Science (in Civil Engineering),
GROVE, C. D.

Civil Engineer:
HERDMAN, G. W.

Catalogue of Students.

GRADUATE.

Buskett, Mary Page.....Rolla.

UNDER-GRADUATES.

SENIOR CLASS.

Buskett, Evans Walker.....Rolla.
Cowen, Herman Cyril.....Bethany.
Dwyer, Edward.....Joplin.
Dyer, Temple.....Rolla,
Florreich, Philip.....St. Louis.
Gormly, Samuel James.....Mt. Vernon, Iowa.
Kirkham, John Edward.....Chicago, Ill.
Vaughan, Robert Edward Lee.....Salem.

JUNIOR CLASS.

Eardley, Albert Edwin.....Carrizo Springs, Texas.
Fleck, Ward Isaiah.....Scotland.
Greenzweight, Alpheus Harmon.....Como, Colo.
Harris, Walter Bibb.....Melbourne, Ark.
Ijima, Zentaro.....Saitamaken, Japan.
Kidd, George Carl.....Nebraska City, Neb.
Offen, Alwin.....Granite, Mont.
Spencer, Herbert Galen.....Joplin.
Suppan, Leo Richard August.....St. Louis.
Torrence, Leslie Clay.....Pocahontas.
Weissgerber, Otto.....Lebanon.
Zelch, John Albert.....Clayton.

SOPHOMORE CLASS.

Anderson, Perry Barton.....Neosho,
Binns, Forest John.....Princeton, Ky.
Bright, William.....St. Louis.
Cameron, John Simpson.....Krebs, I. T.
Dean, George Walter.....Rolla.
Donnelly, Arthur Thomas.....Rolla.
Green, Allen Percy.....Sedalia.
Kersting, Felix.....St. Louis.
Lacey, Ford Schell.....Neosho.
Larsh, Paul Armstrong.....Nebraska City, Neb.
Rogers, John.....Bevier.
Smith, George Washington.....Lachute, Canada.

FRESHMAN CLASS.

Campbell, Eugene.....Rolla.
Cleino, Charles Conrad.....Rolla.
Frein, Walter Jacob.....St. Louis.
Garrison, Lyle.....Webb City.
Gottschalk, Victor Hugo,.....St. Louis.
Groves, Virgil Pitzer.....Springfield.
Hanley, John Alexander, Jr.....Clayton.
Jamison, Claude Eagan.....Rolla.
Knapp, Harlan Burr.....Rolla.
Knapp, Theron Lorenzo.....Rolla.
Lockridge, George William.....Jamesport.
Lunbeck, George Albert.....Holden.
Mitchell, Walter.....Rolla.
Rolufs, Rulof Theodore.....Vest.
Smith, Joseph Henderson.....Rolla.
Soest, Walter Ernest.....Rolla.
Terrell, Arthur Davis.....Holden.

SPECIAL STUDENTS.

Campbell, Joseph Gregory.....Rolla.
Cox, John Charles.....Aspen, Colo.
Cox, William Rowland.....Aspen, Colo.
Crittenden, Alonzo.....New York City, N. Y.
Donnelly, Sophia Mary.....Rolla.
Dulin, Robert Smith.....Liberty.
Hallett, Robert Leland.....Chicago.
Herzinger, John Adam.....Farmington.
Lewis, William Howard.....Gunnison, Colo.
Moll, Walter Herman.....St. Louis.
Parker, Delos Taft.....Kansas City.
Piatt, Philip Noble.....Hamilton, Kansas,
Ponder, Abram Russell.....Kennett.
Torrence, Euart Carl,.....Pocahontas.
Wittmer, Owen Willard,.....St. Louis.

ACADEMIC STUDENTS.

Becker, George William,.....St. Louis,
Bonebrake, Harry Evart,.....Rolla.
Branson, Charles Sylvester,.....Rolla.
Brucher, Edith,.....Rolla.
Burgher, Sylvia,.....Rolla.
Cleino, Henry,.....Rolla.

*Deegan, Agnes Julian,	Rolla.
Flett, James Cyrus,	Salem.
Godwin, Annie Gill,	Rolla.
Heller, Miriam,	Rolla.
Hunt, James William,	Lenox.
Illinski, Alexis,	East St. Louis, Ill.
Kline, Florence,	Rolla.
Livingston, Archibald Armstrong,	Elk Prairie.
Lepper, Anna May,	Rolla.
McCaw, Jean Isabel,	Rolla
McCaw, Norris, Elbert,	Rolla.
Martin, Grace,	Sullivan.
*Morris, Lola J.,	Rolla.
Richards, George Allson,	Rolla.
Shattuck, John Glover,	Arlington.
Soest, Adele,	Rolla.
*Southgate, Margaret Barron,	Rolla.
Strobach, Karl Frederick,	Rolla.
Tretheway, Christopher,	Marquette, Mich.
Via, Jessie Miller,	Rolla.
Watson, John Adolph	Safe.
*Wilkins, Anna Laura,	Rolla.
Wilkins, Elinor Matilda	Rolla.
Yelton, John	Newburg.
Yelton, Milton Burr	Newburg.

SUMMARY BY STATES AND COUNTRIES.

Missouri	76
Colorado	4
Illinois	3
Nebraska	2
Arkansas	1
Indian Territory	1
Iowa	1
Kansas	1
Kentucky	1
Michigan	1
Montana	1
New York	1
Texas	1
Canada	1
Japan	1
TOTAL	96

*Taking advanced or special studies, not technical.

Graduates.

The following is a list of the graduates of the school, with some of the positions held since graduation, and their present occupations and addresses according to latest information attainable. It is earnestly requested that Alumni will notify the Director of any change in location in time for the next catalogue.

1874.

Gustavus A. Duncan, C. E.—Assayer and Mine Superintendent, Colorado, '74–'82; Expert for Emery Bros., Minnesota; now Mine Owner and Examiner, Boston, Mass.

*John Holt Gill, C. E.

John W. Pack, M. E.—Assayer Boulder Smelter, Boulder, Colo., '74–'76; Assayer and Refiner, Montana and California, '76–'85; now Assayer U. S. Mint, San Francisco, Cal.

1875.

*Francis J. Deegan, C. E.—Engineer Louisville, New Orleans and Texas Railway.

Almon W. Hare, M. E.—Chemist and Assayer, Aspen, Colo.

1876.

Cyrus H. Emerson, C. E.—Denison, Tex.

Oscar E. Garvens, M. E.—With Vandalia R. R., East St. Louis, Ill.

John D. Greason, M. E.—Assistant Engineer and Right of Way Agent, D. M. and A. R. R.

John E. McGrath, C. E.—Assistant, U. S. Coast and Geodetic Survey, Washington, D. C. (recently in charge of Government Surveys in Alaska).

William C. Minger, M. E.—Assayer and Chemist in Colorado and, for one year, in Mexico, '76–'93; now Analytical Chemist, Denver, Colo.

1877.

A. H. Ohmann-Dusmesnil, M. E —M. D., St. Louis Medical College, '80; Professor of Dermatology, Marion-Sims Medical College; Physician; Editor of St. Louis *Medical and Surgical Journal;* Author of several medical books and a large number of monographs.

Thomas H. Milsaps, C. E.

James A. Pack, M. E.—Assayer and Chemist, Butte, Montana; General Manager, Black Pine Mining Co.; Mine Engineer and Mill Superintendent, De Lamar Mining Co., De Lamar, Idaho.

1878.

*Wilton R. Brown, M. E.—Assayer, Shakespeare Gold and Silver Mining Co., Shakespeare, New Mexico.

William Y. Bean, C. E.—Engineer Missouri Pacific R. R.

*Lindsay L. Coppedge, C. E.—Engineer Missouri Pacific R. R.

Lee R. Grabill, M. E.—Assayer for Basic Mining Co., Rosita, Colo., '78-'82; Engineer for Gunnison Coal and Iron Co., Crested Butte, Colo., '83; since '83, Assistant Engineer in Government Work on Rivers and Harbors, Washington, D. C.

1879.

Rudolph C. Hoyer, C. E.—Draughtsman U. S. Engineers' Office, Memphis, Tenn.

Charles F. Winters, M. E.—Formerly Assayer in New Mexico ; now Teller Los Angeles National Bank, Los Angeles, Cal.

1880.

Arthur Carson, M. E.—Chemist and Assayer, Butte, Montana.

Lorin X. Smith, M. E., C. E.—Div. Engineer K. C., Ft. S. and Gulf R. R. and same, Denver and New Orleans R. R.; Metallurgist for Flagler Reduction Works; Mill Superintendent, Seina Gravel Co., Lake Valley, New Mexico; Assistant City Engineer, San Diego, Cal.; Mill Superintendent, Hidalgo M. and M. Co., Parral, Mexico; Assayer, E. & E. Co., Baker City, Oregon; Assayer for Tiger & Poorman, Burke, Idaho; Chemist and Superintendent, Pioneer Sampling Works, Wallace, Idaho; Superintendent, and Mining Engineer, Bi-Metallic and Granite Mt. Cos., Philipsburg, Montana; Chemist, Colorado Smelter, Butte, Montana; now mining at Cripple Creek, Colorado.

Edward B. Summers, C. E.—U. S. Topographical Assistant '81–'85; R. R. Engineer, '85–'88; U. S. River and Harbor Work, '88–'91; with King Iron Bridge Co., '91–'94; now draughtsman, Bridge Department, New York Central and Hudson River R. R.

Walter W. Wishon, M. E., Chief Chemist, Montana Ore Purchasing Co., Butte, Mont.

1882.

Herman Neff Van Devander, C. E.—With St. Louis and San Francisco R. R., '82–'83; Engineer, Anniston and Atlantic Ry.; '83–'84; Secretary and Treasurer Southern Mining and Improvement Co.; President and Treasurer North Georgia Mining Co., Cedartown, Ga.

Frank W. Gibb, C. E., M. E.—Mining Engineer and Chemist; now Architect, Little Rock, Ark.

W. P. Painter, C. E.—Editor *Democrat*, Carrollton, Mo.

Beauregard Ross, M. E.—Postmaster, Cameron, Mo.

Ashua B. Schrantz, C. E.—Engineer Union Pacific Railway.

1883.

Floyd Davis, C. E., M. E.—M. Sc., Adrian College; Ph. D., Miami University; Prof. of Chemistry, Va. Agricultural

and Mechanical College, '83–'86; Student Johns Hopkins University '86–'87; Prof. of Chemistry, Drake University, '87–'93; State Chemist of Iowa '88–'93; Acting Prof. of Metallurgy, Wisconsin University, and Commissioner for Iowa to Paris Exposition, '89; Prof. of Chemistry and Toxicology, Iowa College of Physicians and Surgeons, and Dean of Iowa College of Pharmacy, 91–93; President New Mexico School of Mines, '93–95; Author of several books and a number of scientific articles; now Analytical and Consulting Chemist, Des Moines, Ia.

1884.

Curtis Alexander, C. E., M. E.—Assistant Division Engineer Leavenworth, Northern and Southern Railway, '86–'87, Chemist for U. S. Antimony Co., '87–'88; Assayer and Chemist, Mexican Ore Co. Laredo, Tex.; Chief Assayer of Consolidated Kansas City Smelting and Refining Co., Argentine, Kansas.

William M. Claypool, C. E., M. E.—Chemist, Fairbank, Arizona.

Philip C. Gallagher, M. E.—Assayer and Chemist, Leadville, '84–'87; Superintendent Minnie Mine, Breckenridge, Colorado, '87–'88; Assayer, Aspen, Colorado.

Arthur Neustaedter, M. E.—Office of Board of Public Improvements, St. Louis, Mo.; Supt. St. Genevieve Copper Works, St. Genevieve, Mo.; Chemist and Assayer, Butte, Montana.

Frank W. Wilson, C. E.—Draughtsman, Des Moines, Iowa, '84–'85, Transitman, C. R. I. & P. R. R., and C. B. & Q. R. R., '85–'86, Division Engineer, O. & R. V. Branch, U. P. R. R.; Transitman, St. L. & San Francisco R. R. '87, Superintendent of Construction, Atlanta Bridge Co. '88–'89.; Chief Draughtsman, Milwaukee Bridge & Iron Works, '89–'90, Engineer, King Bridge Co., '90–92; Assistant Engineer, Bridge Dept., N. Y. Central

R. R.; now Engineer of Bridges, in charge of all bridge work on N. Y. Central and leased lines, New York, N. Y.

1895.

*John R. D. Owen, M. E.—Assistant in Chemical Laboratory, Missouri School of Mines.

Philip R. Van Frank, M. E.—Transitman, U. S. River Commission, Little Rock, Ark.

Fremont W. Wilson, C. E.—Resident Engineer, St. Louis, K. C. and Colorado R. R. '86-'87; Resident Engineer, Mississippi and Bonne Terre R. R.'88-'89; Assistant Chief Engineer, Middlesborough Belt Railway, Middlesborough, Ky. '90-'91; Division Engineer, Cauca R. R., U. S. of Colombia, '92-'93; Chief Engineer, Chicago, Indiana and Eastern Railway, Fairmount, Ind.

1886.

Jay Cullens, C. E.

Justo G. Martinez, M. E.—Assistant Chemist, Coahuila, Mexico; with Mexican International Railway; now Mine Operator at Guanacevi, Mexico.

James E. Fulcher, C. E.—Draughtsman M. P. R. R. and St. L. and S. F. R. R. '86-87; Principal Aikinsville Institute '88-'90; Prof. Natural Sciences and Mathematics, Nacogdoches University, Texas; Prof. Natural Sciences and Mathematics, McCune College, Louisiana, Mo.

G. W. Cole, C. E.—U. S. Coast Survey; Engineer, Mo. Pacific Ry; Now Second Lieutenant, Seventh U. S. Cavalry (by Presidential appointment), Fort Riley, Kansas.

Oscar Lachmund, M. E.—Chemist for Western Steel Co., St. Louis, Mo., 1887; Bullion Sampler for Holden Smelting Co; Denver, Col; with Grand View Mining and Smelting Co., Reid, Colo; Assayer and Chemist for Idaho Sampling Works, Idaho City, Colo.

George B. Wiles, C. E.—With St. Louis Bridge & Iron Co., St. Louis Mo.

W. Merritt Yeater, M. E.—City Engineer; Sedalia, Mo.

1890.

George Reginald Dean, C. E.—See 1891.

1891.

George Reginald Dean, C. E., B. S.—Assistant in Mathemathics and Engineering, Missouri School of Mines; Prof. of Mathematics, Maryville Seminary, Maryville, Mo.; Prof. of Mathematics and Engineering, Coe College, Iowa; Assistant in Leander McCormick Observatory, University of Virginia; Computer for J. A. F. Waddell, Bridge Engineer, Kansas City, Mo.; Instructor in Mathematics, Central High School, Kansas City, Mo.

Sallie Elizabeth Millard, B. S. (in General Science,) First Assistant Vichy Normal Institute, Vichy, Mo.; First Assistant, High School, Carthage, Mo.

Frank H. Seamon, M. E.—Chemist and Assayer, Vacas Mining and Smelting Co., Mina de Vacas, Estado de Durango, Mexico; Chemist for Guanacevi Mining Co., Guanacevi, Mexico; Ore buyer for La Gran Fundicion Nacional Mexicana, Pachuca, Mexico.

Arthur J. Stewart, B. S.—Assistant in Chemistry, Missouri School of Mines; Assistant Superintendent Notalina Mining Co., La Noria, Estado de Zacatecas, Mexico; Chemist and Assayer, Guanacevi Mining Co., Guanacevi, Mexico.

1892.

Daniel C. Jackling, B. S.—Assistant in Chemistry Missouri School of Mines, '92-'93; Chemist for Lawrence Gold Extraction Co., Lawrence, Colo.

Edward Mackay Johnson, B. Sc.—Chief Chemist for Kansas City Smelting and Refining Co., Argentine, Kan.

Fayette A. Jones, C. E., M. E.—Engineer for Union Mining Co., Phœnix, Arizona, '92-93, Chief Engineer, New Mexico & Western Ry.; City Engineer, Independence, Mo., '94; Engineer for Old Mexico Land and Improvement Co., and Mexican Gulf Agricultural Co., Coatzocoalcas, Mexico.

Frank L. Tyrrell, C. E.—See 1893.

1893.

Mary Page Buskett, B. S. (in General Science.)—Teacher, Phelps Co., Mo.

John Calum Reid, M. E.—Draughtsman, Rolla, Mo.; Assayer for Kansas City, Smelting and Refining Co., Argentine, Kansas.

Clifton Bates Spencer, C. E.—C. E., Cornell University, '94, now at Joplin, Mo.

Frank L. Tyrrell, C. E., M. E.—Assayer for Kansas City Smelting and Refining Co., Argentine, Kansas.

1894.

Theodore S. DeLay, B. S.—Assistant Professor of Chemistry, New Mexico School of Mines; now at Creston, Iowa.

Temple Dyer, C. E., Student of Mining Engineering, Mo. School of Mines.

Claude D. Grove, B. S. (in C. E., and M. E.)—With Lawrence Gold Extraction Co., Lawrence, Colo.

George W. Herdman, C. E., Draughtsman in office of H. H. Hohenschild, Architect, Rolla, Mo.

William S. Thomas, B. S.—Assistant in Chemical Laboratory, Missouri School of Mines.

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